US009253438B2

(12) **United States Patent**
Okita et al.

(10) **Patent No.: US 9,253,438 B2**
(45) **Date of Patent: Feb. 2, 2016**

(54) **TRANSMISSION MANAGEMENT SYSTEM, TRANSMISSION SYSTEM, COMPUTER PROGRAM PRODUCT, PROGRAM PROVIDING SYSTEM, AND MAINTENANCE SYSTEM**

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(72) Inventors: **Kunio Okita**, Kanagawa (JP); **Takahiro Asai**, Kanagawa (JP)

(73) Assignee: **RICOH COMPANY, LIMITED**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Sep. 22, 2014**

(65) **Prior Publication Data**

US 2015/0009281 A1 Jan. 8, 2015

Related U.S. Application Data

(63) Continuation of application No. 13/203,328, filed as application No. PCT/JP2010/073872 on Dec. 24, 2010, now Pat. No. 8,885,008.

(30) **Foreign Application Priority Data**

Dec. 25, 2009	(JP)	2009-294691
Dec. 25, 2009	(JP)	2009-294709
Sep. 3, 2010	(JP)	2010-198144
Sep. 3, 2010	(JP)	2010-198162
Oct. 27, 2010	(JP)	2010-240699
Oct. 27, 2010	(JP)	2010-240704

(51) **Int. Cl.**
H04N 7/14 (2006.01)
H04L 12/18 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04N 7/147*** (2013.01); ***H04L 12/1827*** (2013.01); ***H04L 25/20*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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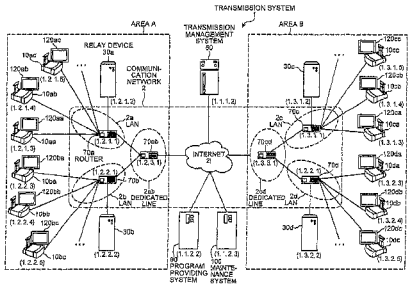
(Continued)

Primary Examiner — Maria El-Zoobi
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A transmission management system includes: a relay device management unit that manages relay device-specifying information for specifying each relay device on a communication network, for every piece of relay device-identification information for identifying each relay device; a terminal management unit that manages terminal-specifying information for specifying each transmission terminal on the communication network; a receiving unit that receives, from a transmission terminal as a predetermined request source, terminal-identification information for the request source and terminal-identification information for a transmission terminal as a destination; an extracting unit that extracts the terminal-specifying information of a corresponding transmission terminal based on the terminal-identification information for the request source; and a primary selecting unit that selects two or more pieces of relay device-identification information of relay devices, to which relay device-specifying information representing top two or more IP addresses closest to the IP address represented by the extracted terminal-specifying information, is allocated.

8 Claims, 20 Drawing Sheets



(51) **Int. Cl.**

H04L 25/20	(2006.01)
H04L 29/08	(2006.01)
H04L 29/12	(2006.01)
H04L 29/06	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L67/1095*** (2013.01); ***H04N 7/142*** (2013.01); ***H04N 7/148*** (2013.01); *H04L 61/6068* (2013.01); *H04L 65/403* (2013.01)

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JP	2009 054139		3/2009

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* cited by examiner

FIG. 1

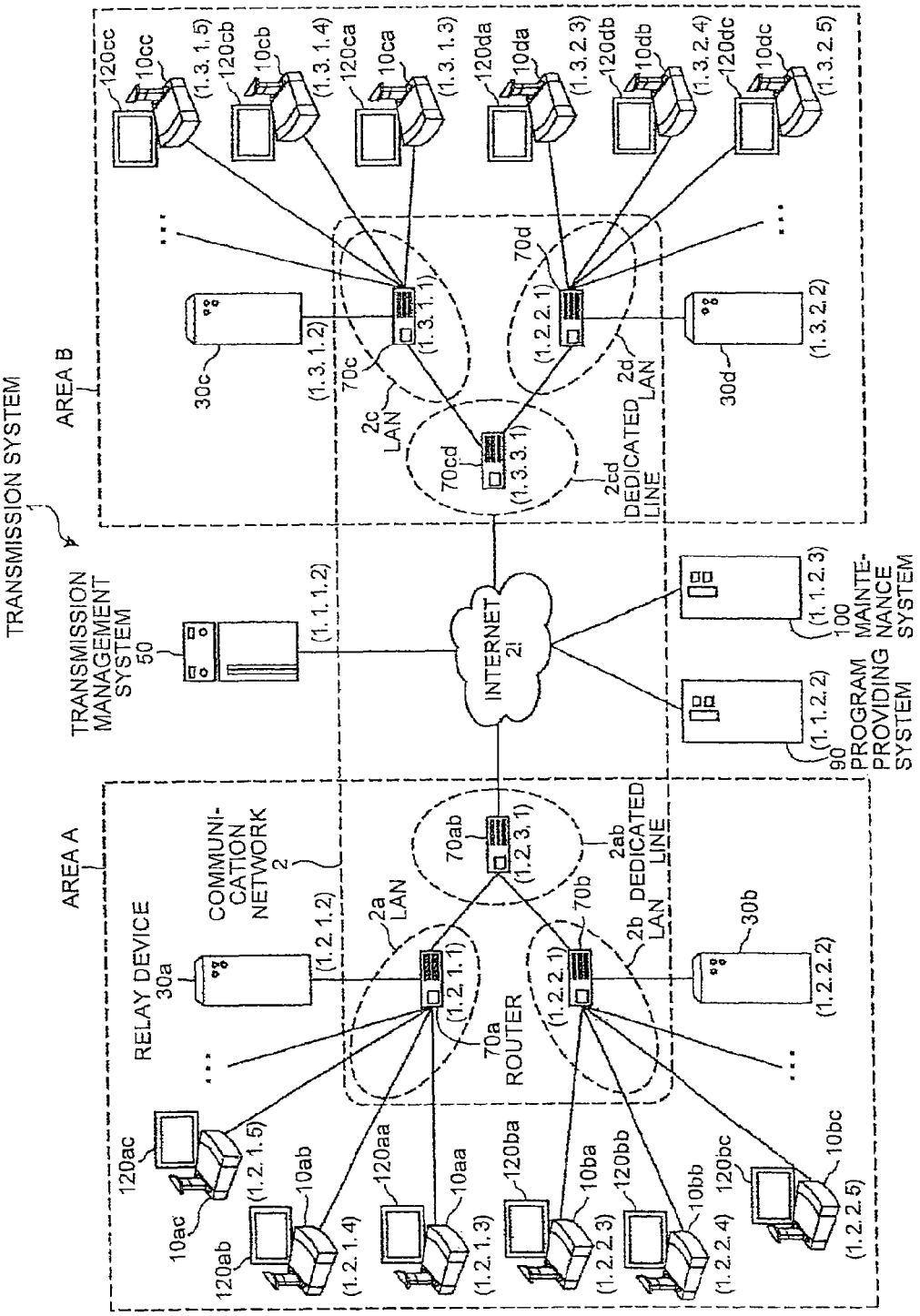

TRANSMISSION SYSTEM
AREA A
AREA B
TRANSMISSION MANAGEMENT SYSTEM 50
(1.1.1.2)
INTERNET 2i
(1.1.2.3) 100 MAINTENANCE SYSTEM
(1.1.2.2) 90 PROGRAM PROVIDING SYSTEM
COMMUNICATION NETWORK 2
RELAY DEVICE 30a
(1.2.1.2)
2a LAN
70ab (1.2.3.1)
2ab DEDICATED LINE
70b (1.2.2.1)
2b LAN
30b (1.2.2.2)
70a ROUTER (1.2.1.1)
120ac 10ac (1.2.1.5)
120ab 10ab (1.2.1.4)
120aa 10aa (1.2.1.3)
120ba 10ba (1.2.2.3)
120bb 10bb (1.2.2.4)
120bc 10bc (1.2.2.5)
30c (1.3.1.2)
70c (1.3.1.1)
2c LAN
120cc 10cc (1.3.1.5)
120cb 10cb (1.3.1.4)
120ca 10ca (1.3.1.3)
70cd (1.3.3.1)
2cd DEDICATED LINE
70d (1.2.2.1)
2d LAN
30d (1.3.2.2)
120da 10da (1.3.2.3)
120db 10db (1.3.2.4)
120dc 10dc (1.3.2.5)

FIG.2

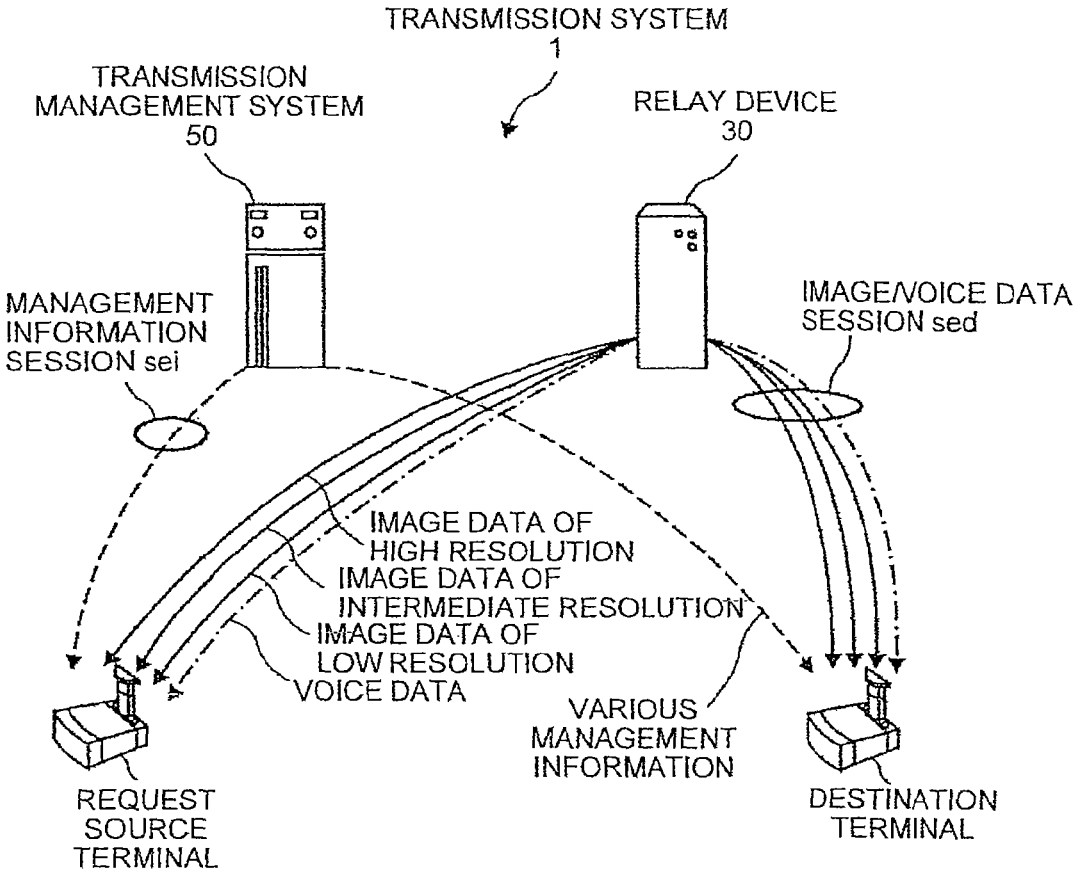


FIG.3A FIG.3B FIG.3C

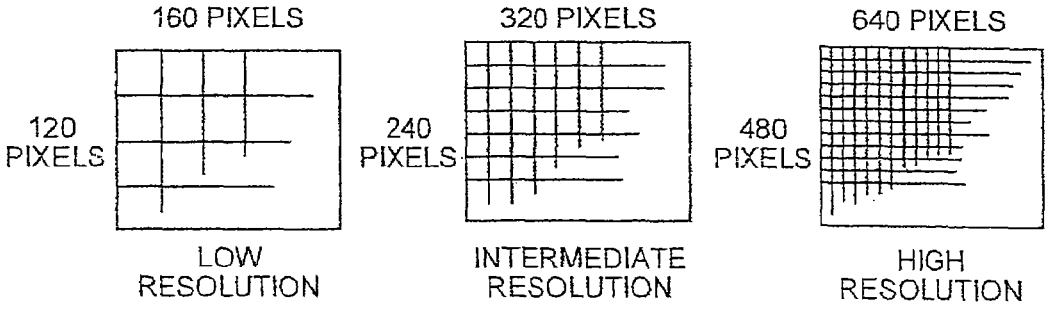


FIG.4

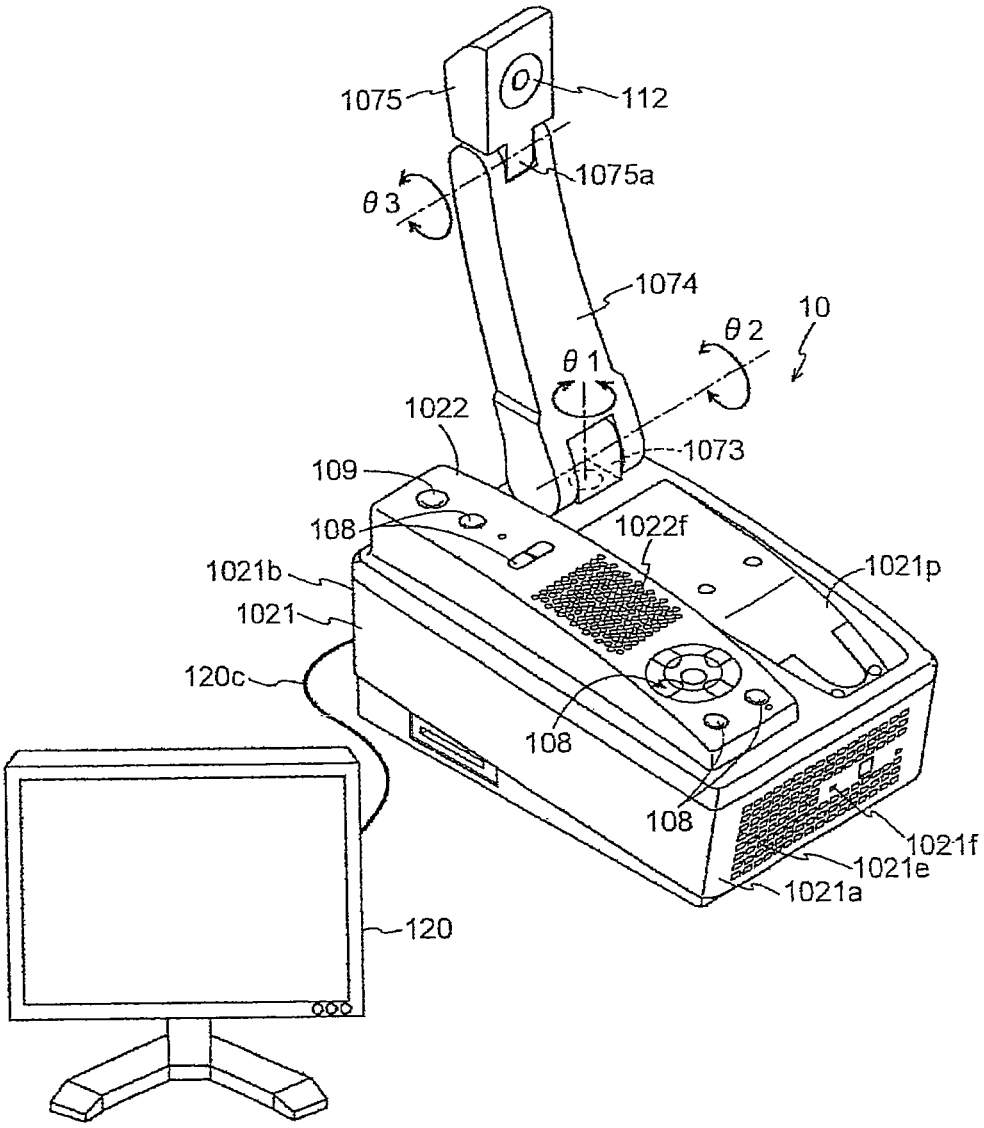

1075
112
1075a
θ3
1074
10
θ2
θ1
1022
1073
109
108
1022f
1021p
1021b
1021
120c
108
108
1021f
1021e
1021a
120

FIG.5

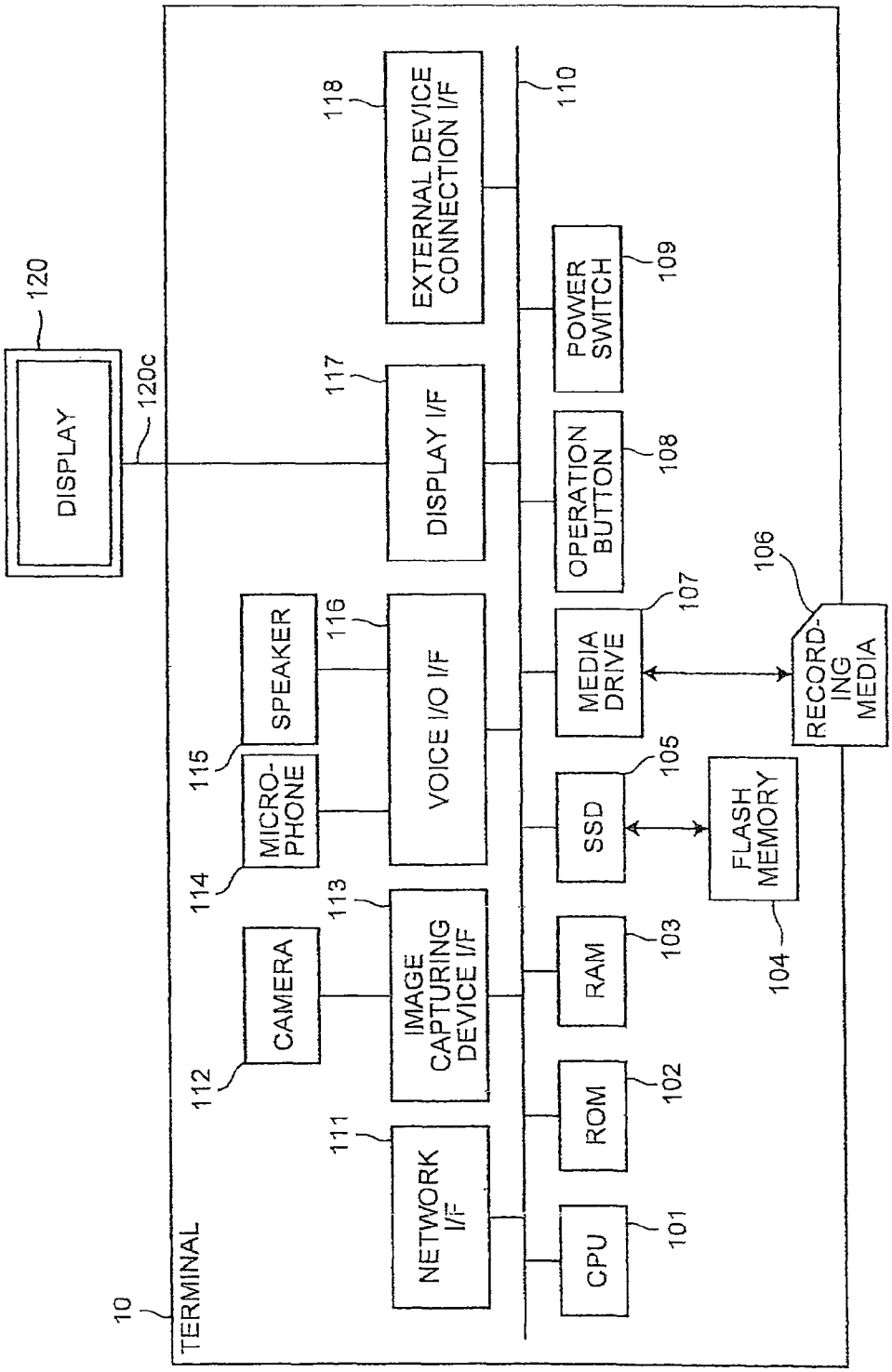

10
TERMINAL
CPU
101
ROM
102
RAM
103
SSD
105
FLASH MEMORY
104
MEDIA DRIVE
107
RECORD-ING MEDIA
106
NETWORK I/F
111
IMAGE CAPTURING DEVICE I/F
113
CAMERA
112
VOICE I/O I/F
116
MICRO-PHONE
114
SPEAKER
115
DISPLAY I/F
117
OPERATION BUTTON
108
POWER SWITCH
109
EXTERNAL DEVICE CONNECTION I/F
118
110
DISPLAY
120
120c

FIG.6

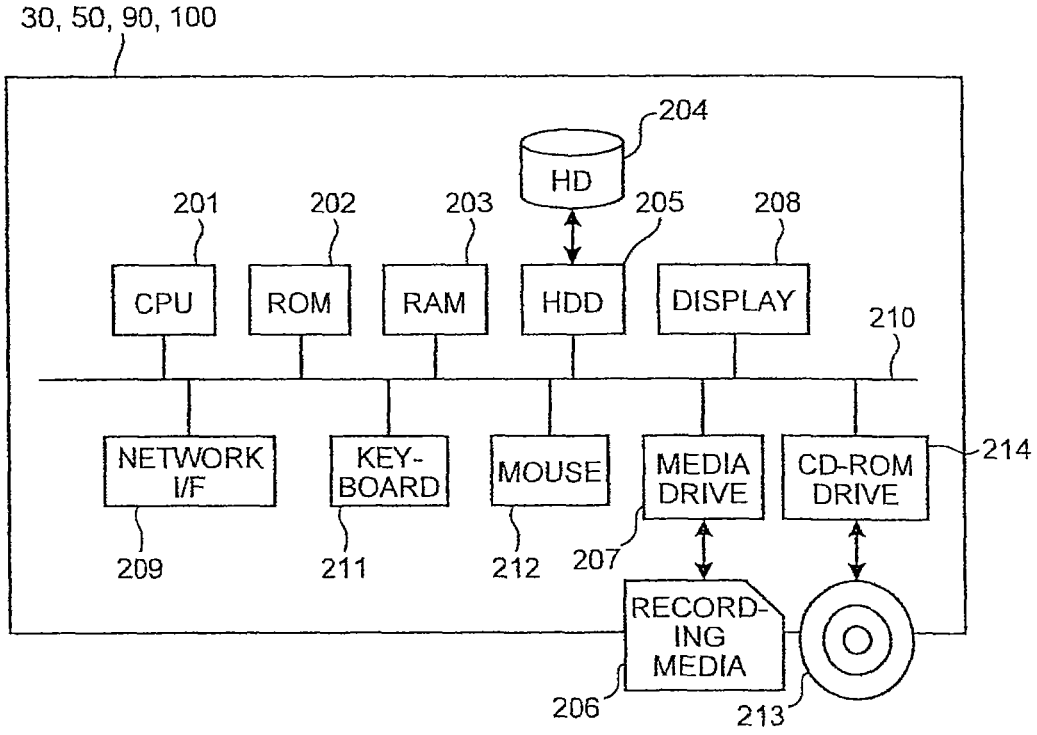

30, 50, 90, 100
204
HD
201
202
203
205
208
CPU
ROM
RAM
HDD
DISPLAY
210
NETWORK I/F
KEY-BOARD
MOUSE
MEDIA DRIVE
CD-ROM DRIVE
214
209
211
212
207
RECORD-ING MEDIA
206
213

FIG.7

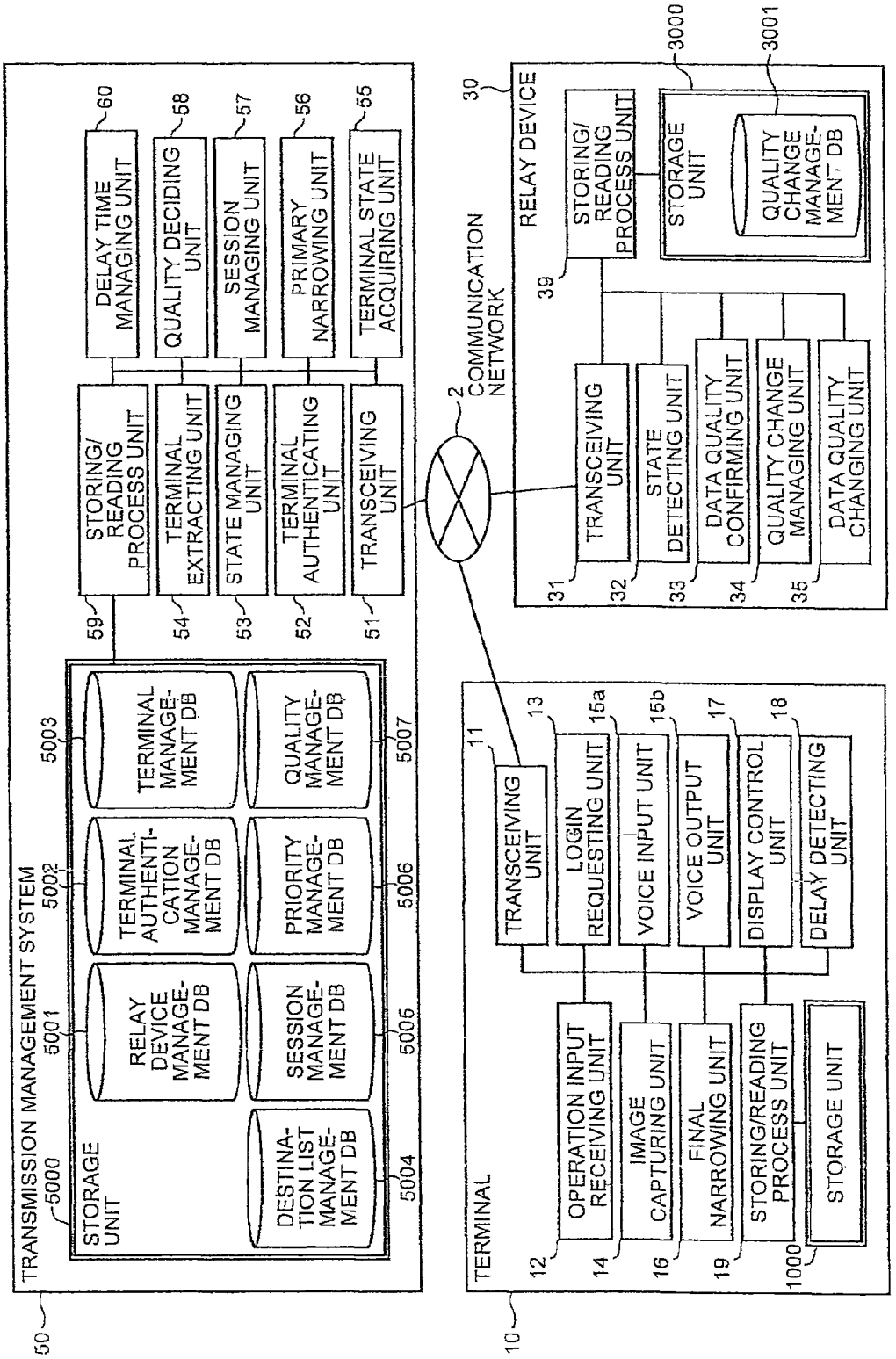

TRANSMISSION MANAGEMENT SYSTEM
50
STORAGE UNIT
5000
RELAY DEVICE MANAGEMENT DB
5001
TERMINAL AUTHENTICATION MANAGEMENT DB
5002
TERMINAL MANAGEMENT DB
5003
DESTINATION LIST MANAGEMENT DB
5004
SESSION MANAGEMENT DB
5005
PRIORITY MANAGEMENT DB
5006
QUALITY MANAGEMENT DB
5007
STORING/READING PROCESS UNIT
59
TERMINAL EXTRACTING UNIT
54
STATE MANAGING UNIT
53
TERMINAL AUTHENTICATING UNIT
52
TRANSCEIVING UNIT
51
DELAY TIME MANAGING UNIT
60
QUALITY DECIDING UNIT
58
SESSION MANAGING UNIT
57
PRIMARY NARROWING UNIT
56
TERMINAL STATE ACQUIRING UNIT
55
2
COMMUNICATION NETWORK
RELAY DEVICE
30
TRANSCEIVING UNIT
31
STORING/READING PROCESS UNIT
39
STATE DETECTING UNIT
32
DATA QUALITY CONFIRMING UNIT
33
QUALITY CHANGE MANAGING UNIT
34
DATA QUALITY CHANGING UNIT
35
STORAGE UNIT
3000
QUALITY CHANGE MANAGEMENT DB
3001
TERMINAL
10
TRANSCEIVING UNIT
11
OPERATION INPUT RECEIVING UNIT
12
LOGIN REQUESTING UNIT
13
IMAGE CAPTURING UNIT
14
VOICE INPUT UNIT
15a
FINAL NARROWING UNIT
16
VOICE OUTPUT UNIT
15b
STORING/READING PROCESS UNIT
19
DISPLAY CONTROL UNIT
17
STORAGE UNIT
1000
DELAY DETECTING UNIT
18

FIG.8

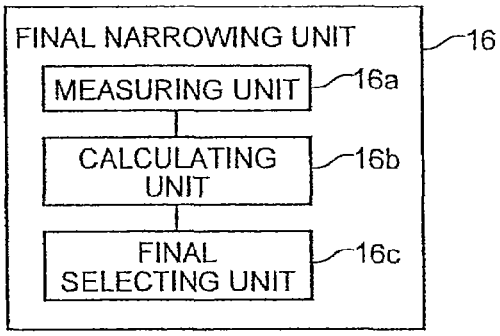


FIG.9

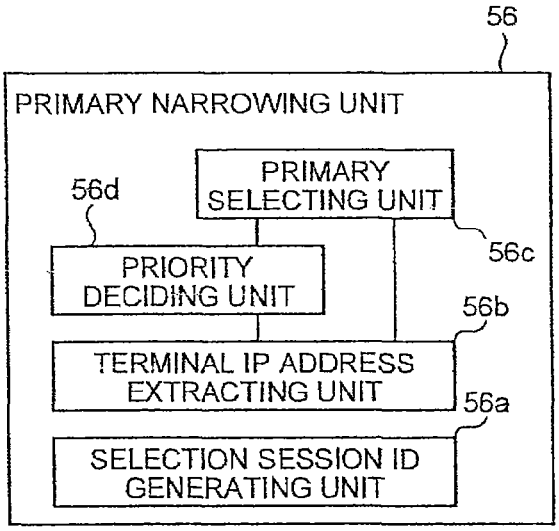


FIG.10

QUALITY CHANGE MANAGEMENT TABLE

IP ADDRESS OF RELAY DESTINATION TERMINAL	IMAGE QUALITY OF IMAGE DATA TO BE RELAYED (QUALITY OF IMAGE)
1. 3. 2. 4	HIGH QUALITY
1. 3. 1. 3	LOW QUALITY
1. 3. 2. 3	INTERMEDIATE QUALITY
...	...

FIG.11

RELAY DEVICE MANAGEMENT TABLE

RELAY DEVICE ID	OPERATION STATE	RECEPTION DATE AND TIME	IP ADDRESS OF RELAY DEVICE	MAXIMUM DATA TRANSMISSION RATE [Mbps]
111a	ON LINE	2009. 11. 10. 13:00	1. 2. 1. 2	100
111b	ON LINE	2009. 11. 10. 13:10	1. 2. 2. 2	1000
111c	OFF LINE	2009. 11. 10. 13:20	1. 3. 1. 2	100
111d	ON LINE	2009. 11. 10. 13:30	1. 3. 2. 2	10

FIG.12

TERMINAL AUTHENTICATION MANAGEMENT TABLE

TERMINAL ID	PASSWORD
01aa	aaaa
01ab	abab
01ba	baba
...	...

FIG.13

TERMINAL MANAGEMENT TABLE

TERMINAL ID	DESTINATION NAME	OPERATION STATE	RECEPTION DATE AND TIME	IP ADDRESS OF TERMINAL
01aa	AA TERMINAL IN TOKYO OFFICE IN JAPAN	ON LINE (CALL ENABLE)	2009. 11. 10. 13:40	1. 2. 1. 3
01ab	AB TERMINAL IN TOKYO OFFICE IN JAPAN	OFF LINE	2009. 11. 09. 12:00	1. 2. 1. 4
...	...	...	...	...
01ba	BA TERMINAL IN OSAKA OFFICE IN JAPAN	ON LINE (TEMPORARY HALT)	2009. 11. 10. 13:45	1. 2. 2. 3
01bb	BB TERMINAL IN OSAKA OFFICE IN JAPAN	ON LINE (CALL ENABLE)	2009. 11. 10. 13:50	1. 2. 2. 4
...	...	...	...	...
01ca	CA TERMINAL IN NEW YORK OFFICE IN USA	OFF LINE	2009. 11. 10. 12:45	1. 3. 1. 3
01cb	CB TERMINAL IN NEW YORK OFFICE IN USA	ON LINE (BUSY)	2009. 11. 10. 13:55	1. 3. 1. 4
...	...	...	...	...
01da	DA TERMINAL IN WASHINGTON OFFICE IN USA	ON LINE (BUSY)	2009. 11. 08. 12:45	1. 3. 2. 3
01db	DB TERMINAL IN WASHINGTON OFFICE IN USA	ON LINE	2009. 11. 10. 12:45	1. 3. 2. 4
...	...	...	...	...

FIG.14

DESTINATION LIST MANAGEMENT TABLE

REQUEST SOURCE TERMINAL ID	DESTINATION TERMINAL ID
01aa	01ab, ···, 01ba, 01bb, ···, 01ca, 01cb, 01da, 01db, ···
01ab	01aa, 01ca, 01cb
01ba	01aa, 01ab, 01ca, 01cb, 01da, 01db
···	···
01db	01aa, 01ab, 01ba, ···, 01da, 01ca, 01cb, ···, 01da

FIG.15

SESSION MANAGEMENT TABLE

SESSION ID FOR SELECTION	RELAY DEVICE ID	REQUEST SOURCE TERMINAL ID	DESTINATION TERMINAL ID	DELAY TIME [ms]	DATE AND TIME WHEN DELAY INFORMATION IS RECEIVED
se1	111a	01aa	01db	200	2009. 11. 10. 14:00
se2	111b	01ba	01ca	50	2009. 11. 10. 14:10
se3	111d	01bb	01da	400	2009. 11. 10. 14:20
···	···	···	···	···	···

FIG.16

ADDRESS PRIORITY MANAGEMENT TABLE

SAME/DIFFERENT PART OF DOT ADDRESS	ADDRESS PRIORITY
SAME. SAME. SAME. DIFFERENT	5
SAME. SAME. DIFFERENT. -	3
SAME. DIFFERENT. -. -	1
DIFFERENT. -. -. -	0

FIG.17

TRANSMISSION RATE AND PRIORITY MANAGEMENT TABLE

MAXIMUM DATA TRANSMISSION RATE [Mbps] IN RELAY DEVICE	TRANSMISSION RATE PRIORITY
1000 TO	5
100 TO 1000	3
10 TO 100	1
TO 10	0

FIG.18

QUALITY MANAGEMENT TABLE

DELAY TIME [ms]	IMAGE QUALITY OF IMAGE DATA (QUALITY OF IMAGE)
0 TO 100	HIGH QUALITY
100 TO 300	INTERMEDIATE QUALITY
300 TO 500	LOW QUALITY
500 TO	(HALT)

FIG.19

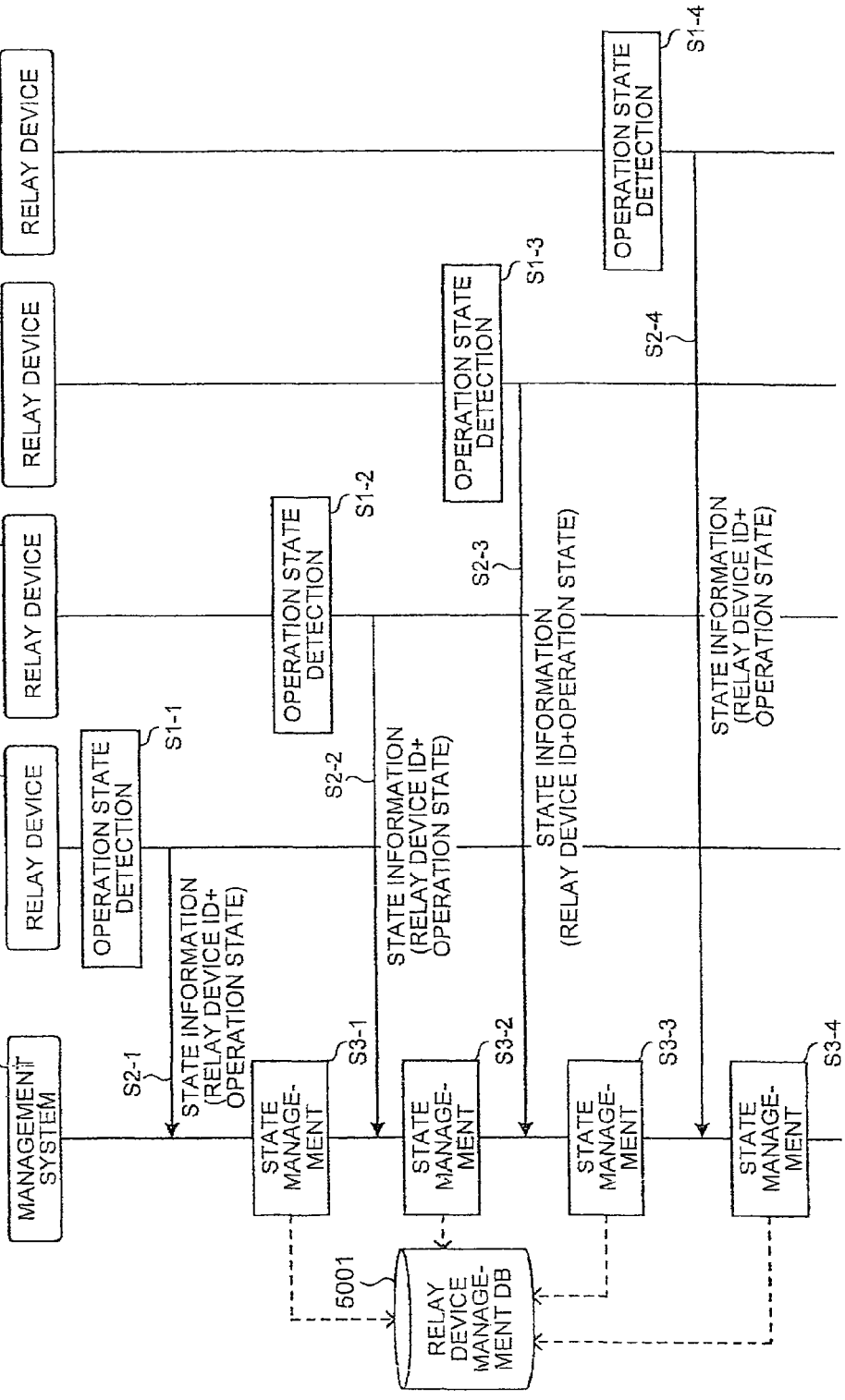

50
MANAGEMENT SYSTEM
30a
RELAY DEVICE
30b
RELAY DEVICE
30c
RELAY DEVICE
30d
RELAY DEVICE
OPERATION STATE DETECTION
S1-1
OPERATION STATE DETECTION
S1-2
OPERATION STATE DETECTION
S1-3
OPERATION STATE DETECTION
S1-4
S2-1
STATE INFORMATION (RELAY DEVICE ID+ OPERATION STATE)
S2-2
STATE INFORMATION (RELAY DEVICE ID+ OPERATION STATE)
S2-3
STATE INFORMATION (RELAY DEVICE ID+OPERATION STATE)
S2-4
STATE INFORMATION (RELAY DEVICE ID+ OPERATION STATE)
STATE MANAGE-MENT
S3-1
STATE MANAGE-MENT
S3-2
STATE MANAGE-MENT
S3-3
STATE MANAGE-MENT
S3-4
5001
RELAY DEVICE MANAGE-MENT DB

FIG.20

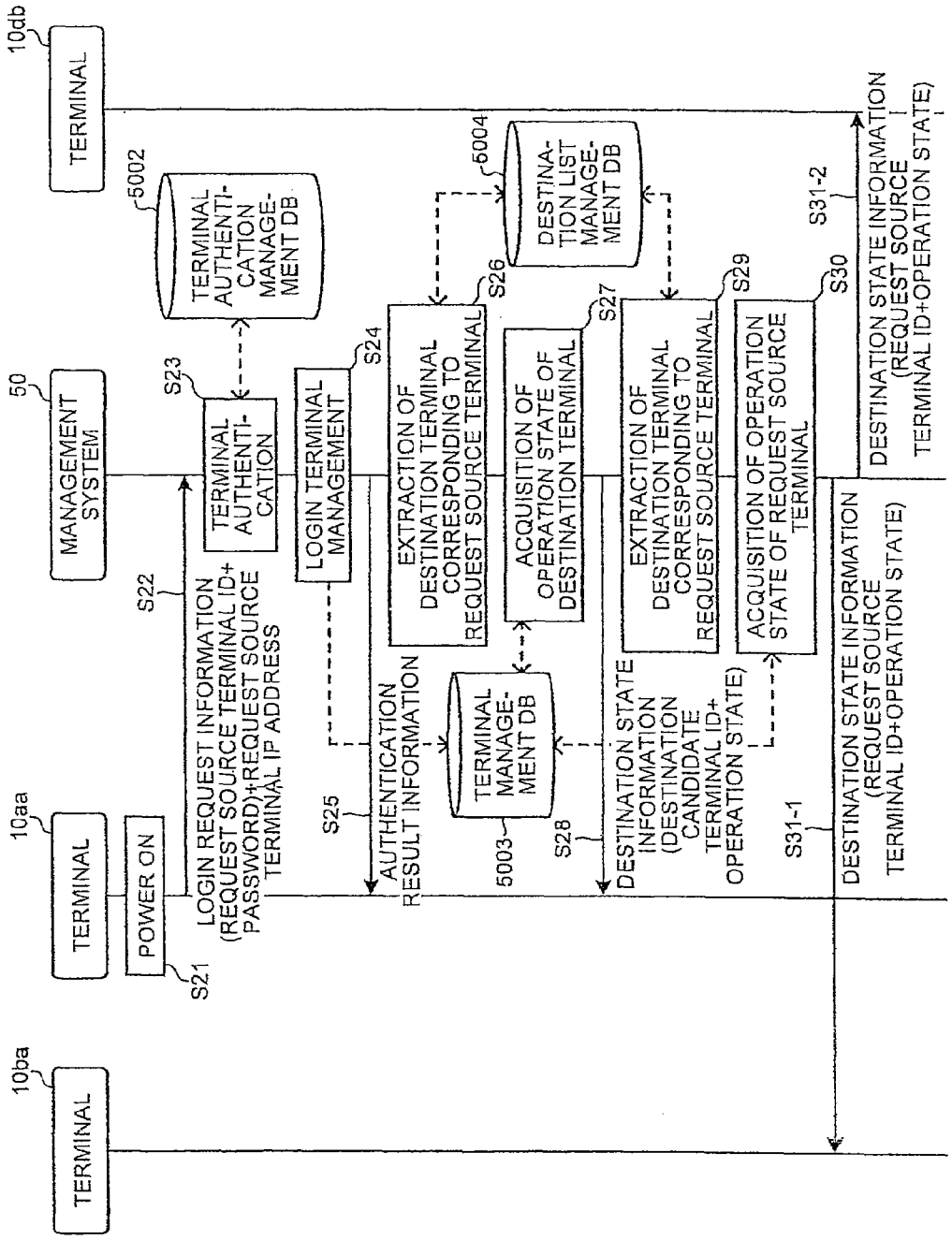

10ba
TERMINAL
10aa
TERMINAL
POWER ON
S21
50
MANAGEMENT SYSTEM
S22
LOGIN REQUEST INFORMATION (REQUEST SOURCE TERMINAL ID+PASSWORD)+REQUEST SOURCE TERMINAL IP ADDRESS
S23
TERMINAL AUTHENTICATION
5002
TERMINAL AUTHENTICATION MANAGEMENT DB
LOGIN TERMINAL MANAGEMENT
S24
AUTHENTICATION RESULT INFORMATION
S25
5003
TERMINAL MANAGEMENT DB
EXTRACTION OF DESTINATION TERMINAL CORRESPONDING TO REQUEST SOURCE TERMINAL
S26
5004
DESTINATION LIST MANAGEMENT DB
ACQUISITION OF OPERATION STATE OF DESTINATION TERMINAL
S27
S28
DESTINATION STATE INFORMATION (DESTINATION CANDIDATE TERMINAL ID+OPERATION STATE)
EXTRACTION OF DESTINATION TERMINAL CORRESPONDING TO REQUEST SOURCE TERMINAL
S29
ACQUISITION OF OPERATION STATE OF REQUEST SOURCE TERMINAL
S30
S31-1
DESTINATION STATE INFORMATION (REQUEST SOURCE TERMINAL ID+OPERATION STATE)
S31-2
DESTINATION STATE INFORMATION (REQUEST SOURCE TERMINAL ID+OPERATION STATE)
10db
TERMINAL

FIG.21

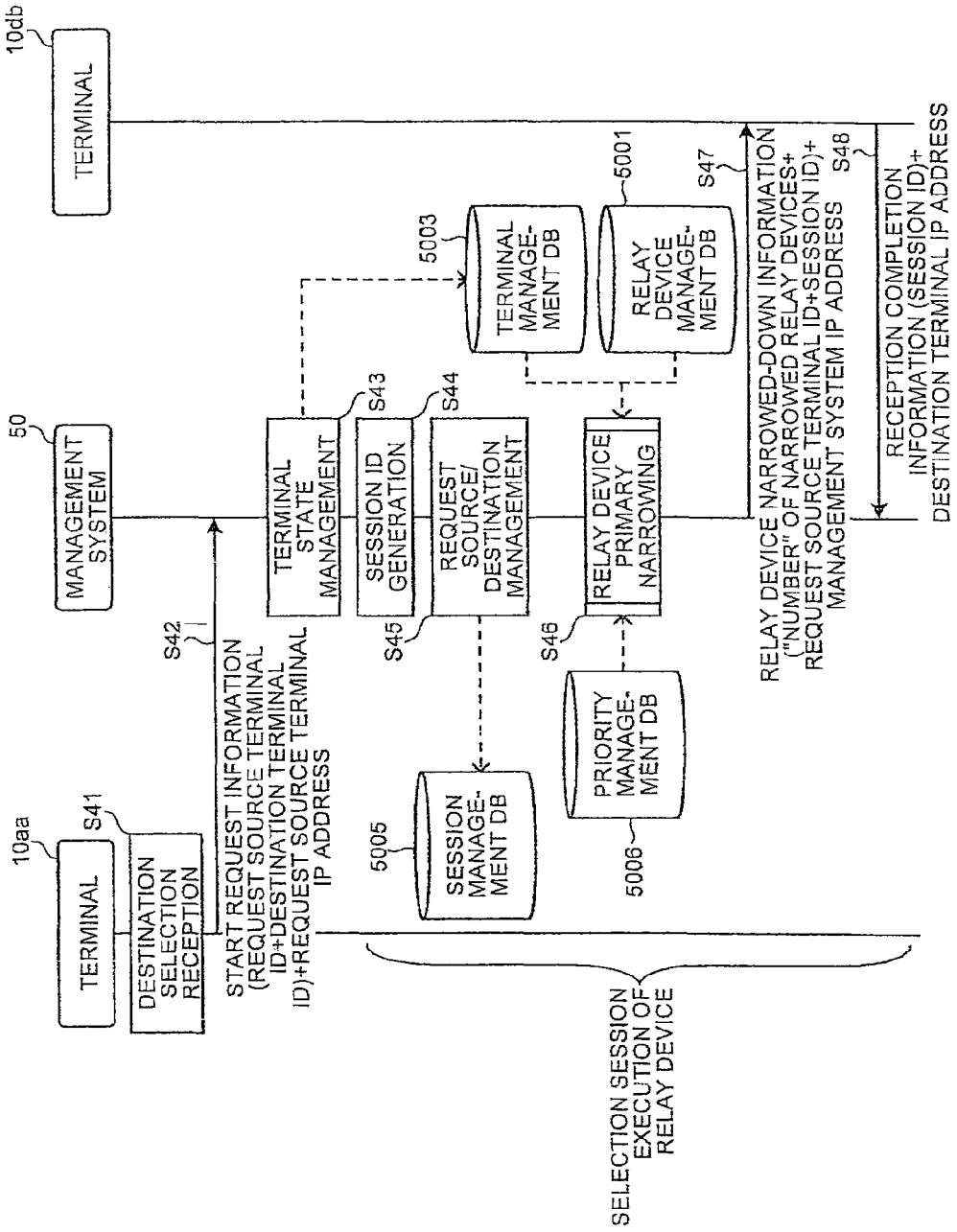

10db
TERMINAL
50
MANAGEMENT SYSTEM
10aa
TERMINAL
S41
DESTINATION SELECTION RECEPTION
S42
START REQUEST INFORMATION (REQUEST SOURCE TERMINAL ID+DESTINATION TERMINAL ID)+REQUEST SOURCE TERMINAL IP ADDRESS
TERMINAL STATE MANAGEMENT
S43
SESSION ID GENERATION
S44
REQUEST SOURCE/ DESTINATION MANAGEMENT
S45
RELAY DEVICE PRIMARY NARROWING
S46
5003
TERMINAL MANAGE-MENT DB
5001
RELAY DEVICE MANAGE-MENT DB
S47
RELAY DEVICE NARROWED-DOWN INFORMATION ("NUMBER" OF NARROWED RELAY DEVICES+ REQUEST SOURCE TERMINAL ID+SESSION ID)+ MANAGEMENT SYSTEM IP ADDRESS
S48
RECEPTION COMPLETION INFORMATION (SESSION ID)+ DESTINATION TERMINAL IP ADDRESS
5005
SESSION MANAGE-MENT DB
5006
PRIORITY MANAGE-MENT DB
SELECTION SESSION EXECUTION OF RELAY DEVICE

FIG.22

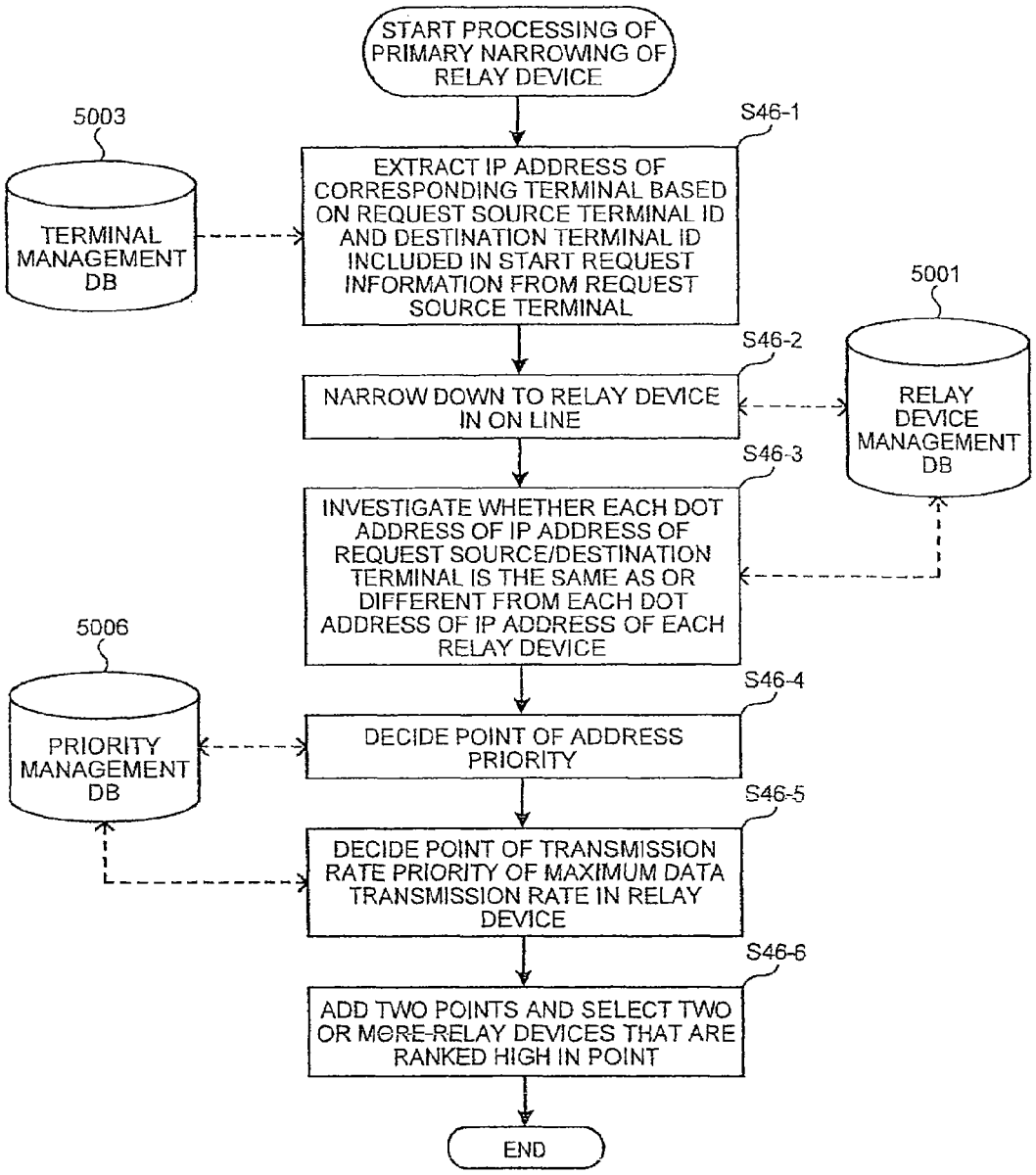

START PROCESSING OF PRIMARY NARROWING OF RELAY DEVICE
5003
TERMINAL MANAGEMENT DB
S46-1
EXTRACT IP ADDRESS OF CORRESPONDING TERMINAL BASED ON REQUEST SOURCE TERMINAL ID AND DESTINATION TERMINAL ID INCLUDED IN START REQUEST INFORMATION FROM REQUEST SOURCE TERMINAL
5001
RELAY DEVICE MANAGEMENT DB
S46-2
NARROW DOWN TO RELAY DEVICE IN ON LINE
S46-3
INVESTIGATE WHETHER EACH DOT ADDRESS OF IP ADDRESS OF REQUEST SOURCE/DESTINATION TERMINAL IS THE SAME AS OR DIFFERENT FROM EACH DOT ADDRESS OF IP ADDRESS OF EACH RELAY DEVICE
5006
PRIORITY MANAGEMENT DB
S46-4
DECIDE POINT OF ADDRESS PRIORITY
S46-5
DECIDE POINT OF TRANSMISSION RATE PRIORITY OF MAXIMUM DATA TRANSMISSION RATE IN RELAY DEVICE
S46-6
ADD TWO POINTS AND SELECT TWO OR MORE-RELAY DEVICES THAT ARE RANKED HIGH IN POINT
END

FIG.23

RELAY DEVICE ID	ADDRESS PRIORITY		POINT OF TRANSMISSION RATE PRIORITY	INTEGRATED POINT
	POINT ON TERMINAL 10aa	POINT ON TERMINAL 10db		
111a	5	1	3	8
111b	3	1	5	8
111c	-	-	-	-
111d	1	5	1	6

FIG.24

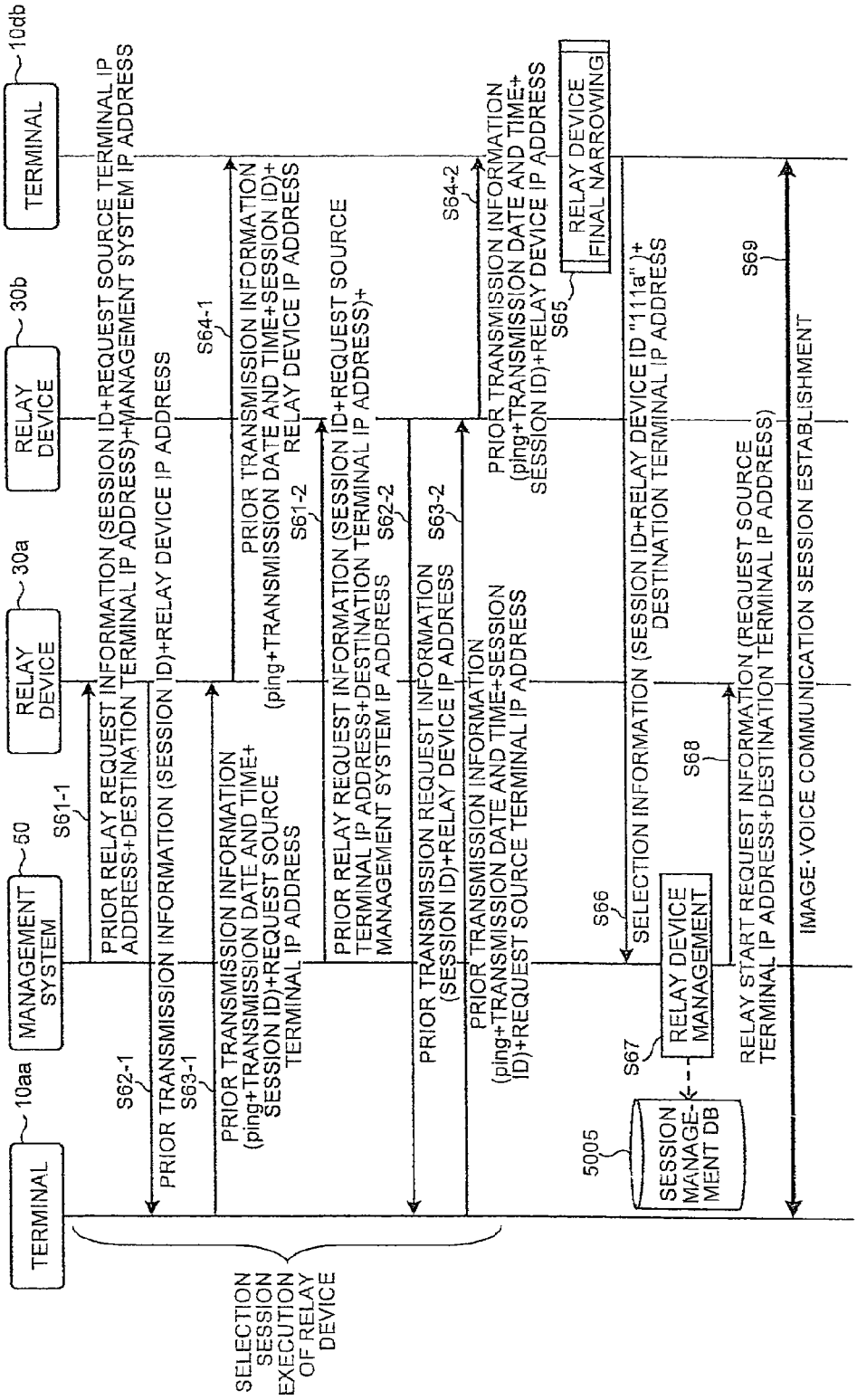

TERMINAL
10aa
MANAGEMENT SYSTEM
50
RELAY DEVICE
30a
RELAY DEVICE
30b
TERMINAL
10db
SELECTION SESSION EXECUTION OF RELAY DEVICE
S61-1
PRIOR RELAY REQUEST INFORMATION (SESSION ID+REQUEST SOURCE TERMINAL IP ADDRESS+DESTINATION TERMINAL IP ADDRESS)+MANAGEMENT SYSTEM IP ADDRESS
S62-1
PRIOR TRANSMISSION INFORMATION (SESSION ID)+RELAY DEVICE IP ADDRESS
S63-1
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID)+REQUEST SOURCE TERMINAL IP ADDRESS
S64-1
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID)+RELAY DEVICE IP ADDRESS
S61-2
PRIOR RELAY REQUEST INFORMATION (SESSION ID+REQUEST SOURCE TERMINAL IP ADDRESS+DESTINATION TERMINAL IP ADDRESS)+MANAGEMENT SYSTEM IP ADDRESS
S62-2
PRIOR TRANSMISSION REQUEST INFORMATION (SESSION ID)+RELAY DEVICE IP ADDRESS
S63-2
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID)+REQUEST SOURCE TERMINAL IP ADDRESS
S64-2
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID)+RELAY DEVICE IP ADDRESS
S65
RELAY DEVICE FINAL NARROWING
S66
SELECTION INFORMATION (SESSION ID+RELAY DEVICE ID "111a")+DESTINATION TERMINAL IP ADDRESS
S67
5005
SESSION MANAGEMENT DB
RELAY DEVICE MANAGEMENT
S68
RELAY START REQUEST INFORMATION (REQUEST SOURCE TERMINAL IP ADDRESS+DESTINATION TERMINAL IP ADDRESS)
S69
IMAGE·VOICE COMMUNICATION SESSION ESTABLISHMENT

FIG.25

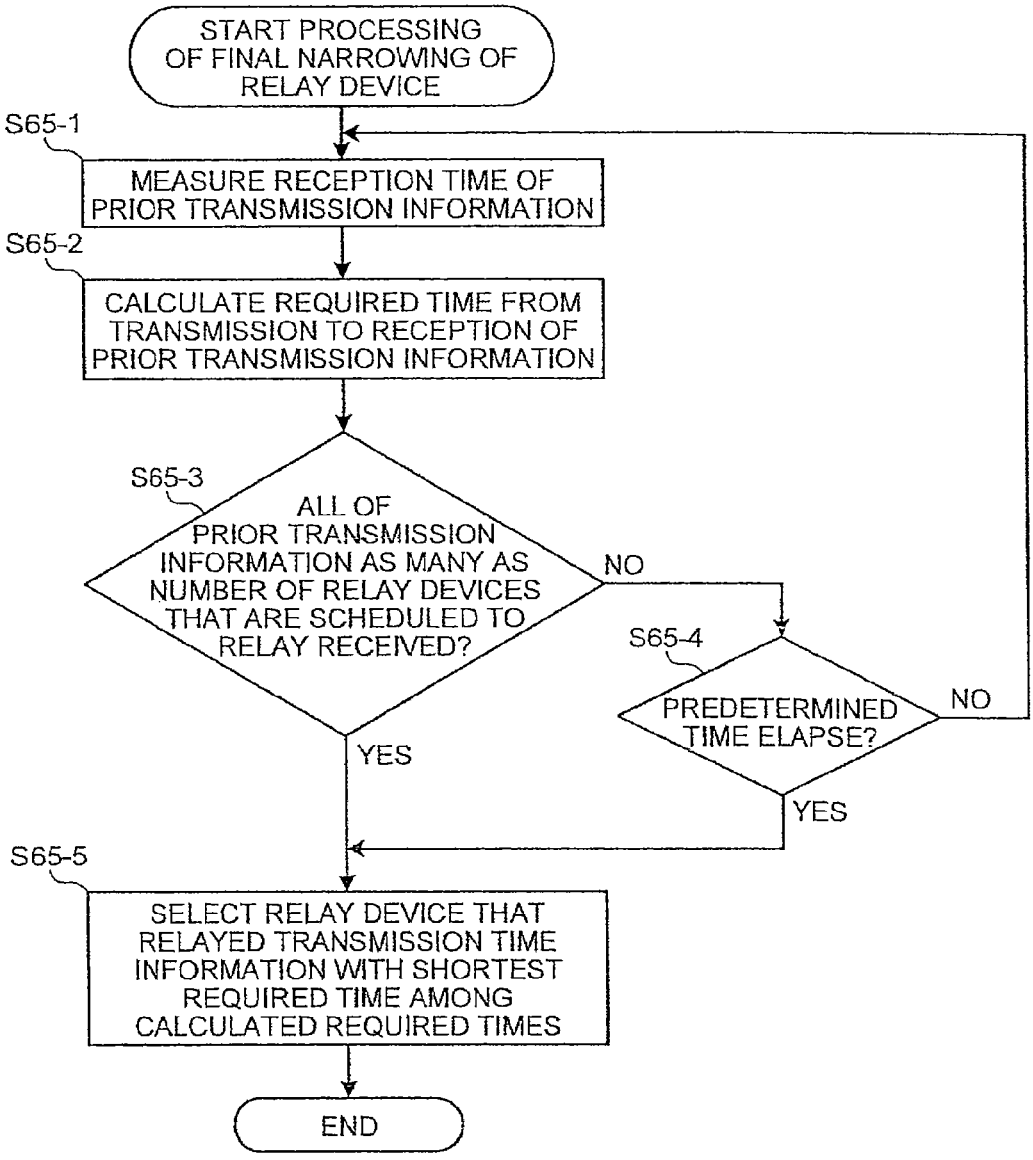

START PROCESSING OF FINAL NARROWING OF RELAY DEVICE
S65-1
MEASURE RECEPTION TIME OF PRIOR TRANSMISSION INFORMATION
S65-2
CALCULATE REQUIRED TIME FROM TRANSMISSION TO RECEPTION OF PRIOR TRANSMISSION INFORMATION
S65-3
ALL OF PRIOR TRANSMISSION INFORMATION AS MANY AS NUMBER OF RELAY DEVICES THAT ARE SCHEDULED TO RELAY RECEIVED?
NO
S65-4
PREDETERMINED TIME ELAPSE?
NO
YES
YES
S65-5
SELECT RELAY DEVICE THAT RELAYED TRANSMISSION TIME INFORMATION WITH SHORTEST REQUIRED TIME AMONG CALCULATED REQUIRED TIMES
END

FIG.26

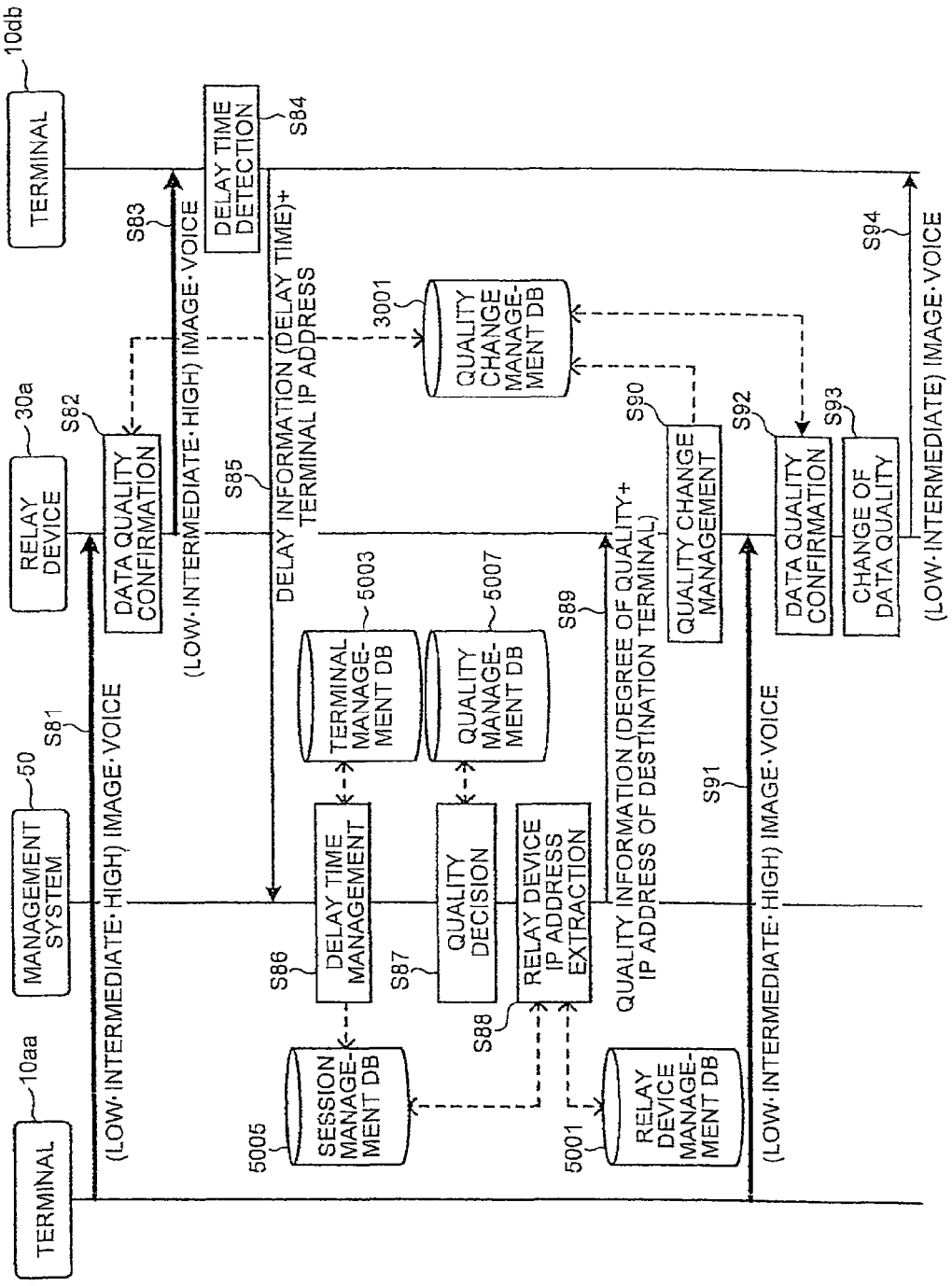
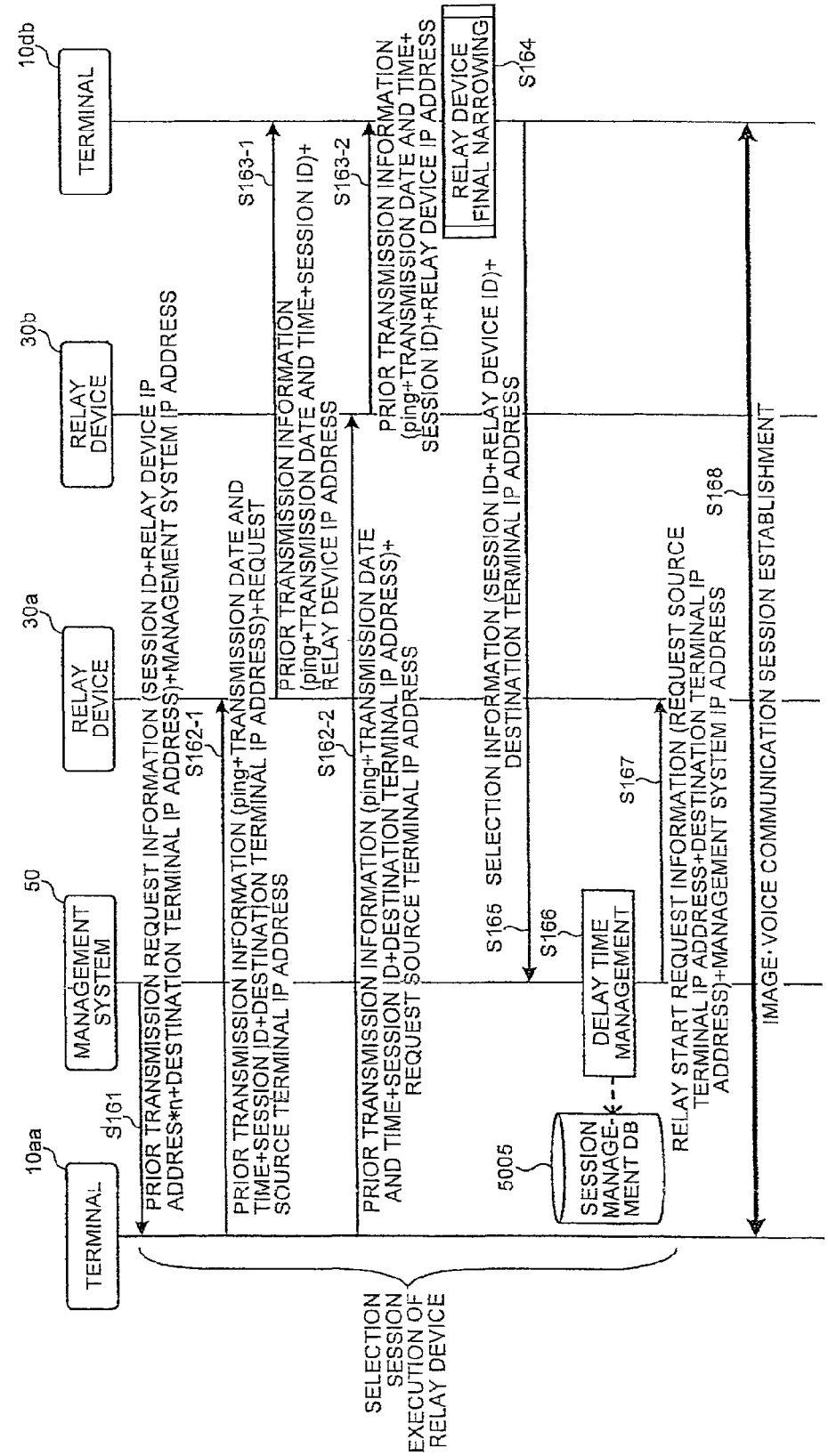

TERMINAL
10aa
MANAGEMENT SYSTEM
50
RELAY DEVICE
30a
TERMINAL
10db
S81
(LOW·INTERMEDIATE·HIGH) IMAGE·VOICE
S82
DATA QUALITY CONFIRMATION
S83
(LOW·INTERMEDIATE·HIGH) IMAGE·VOICE
DELAY TIME DETECTION
S84
S85
DELAY INFORMATION (DELAY TIME)+ TERMINAL IP ADDRESS
3001
QUALITY CHANGE MANAGE-MENT DB
S86
DELAY TIME MANAGEMENT
5003
TERMINAL MANAGE-MENT DB
S87
QUALITY DECISION
5007
QUALITY MANAGE-MENT DB
S88
RELAY DEVICE IP ADDRESS EXTRACTION
S89
QUALITY INFORMATION (DEGREE OF QUALITY+ IP ADDRESS OF DESTINATION TERMINAL)
S90
QUALITY CHANGE MANAGEMENT
S91
(LOW·INTERMEDIATE·HIGH) IMAGE·VOICE
S92
DATA QUALITY CONFIRMATION
S93
CHANGE OF DATA QUALITY
S94
(LOW·INTERMEDIATE) IMAGE·VOICE
5005
SESSION MANAGE-MENT DB
5001
RELAY DEVICE MANAGE-MENT DB

FIG.27


10aa
TERMINAL
50
MANAGEMENT SYSTEM
30a
RELAY DEVICE
30b
RELAY DEVICE
10db
TERMINAL
S161
PRIOR TRANSMISSION REQUEST INFORMATION (SESSION ID+RELAY DEVICE IP ADDRES*n+DESTINATION TERMINAL IP ADDRESS)+MANAGEMENT SYSTEM IP ADDRESS
S162-1
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID+DESTINATION TERMINAL IP ADDRESS)+REQUEST SOURCE TERMINAL IP ADDRESS
S162-2
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID+DESTINATION TERMINAL IP ADDRESS)+ REQUEST SOURCE TERMINAL IP ADDRESS
S163-1
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+SESSION ID)+ RELAY DEVICE IP ADDRESS
S163-2
PRIOR TRANSMISSION INFORMATION (ping+TRANSMISSION DATE AND TIME+ SESSION ID)+RELAY DEVICE IP ADDRESS
RELAY DEVICE FINAL NARROWING
S164
S165
SELECTION INFORMATION (SESSION ID+RELAY DEVICE ID)+ DESTINATION TERMINAL IP ADDRESS
S166
DELAY TIME MANAGEMENT
S167
RELAY START REQUEST INFORMATION (REQUEST SOURCE TERMINAL IP ADDRESS+DESTINATION TERMINAL IP ADDRESS)+MANAGEMENT SYSTEM IP ADDRESS
S168
IMAGE· VOICE COMMUNICATION SESSION ESTABLISHMENT
5005
SESSION MANAGE-MENT DB
SELECTION SESSION EXECUTION OF RELAY DEVICE

TRANSMISSION MANAGEMENT SYSTEM, TRANSMISSION SYSTEM, COMPUTER PROGRAM PRODUCT, PROGRAM PROVIDING SYSTEM, AND MAINTENANCE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation application of U.S. patent application Ser. No. 13/203,328, filed Aug. 25, 2011, which is a National Stage application of PCT/JP2010/073872 filed on Dec. 24, 2010, and claims priority to Japanese Patent Application Nos. 2010-240704, filed Oct. 27, 2010; 2010-240699, filed Oct. 27, 2010; 2010-198162, filed Sep. 3, 2010; 2010-198144, filed Sep. 3, 2010; 2009-294709, filed Dec. 25, 2009; 2009-294691, filed Dec. 25, 2009. The entire contents of the above-identified applications are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a technique of selecting a relay device that actually relays contents data from among a plurality of replay devices capable of relaying contents data between a plurality of transmission terminals.

BACKGROUND ART

As an example of a transmission system in which contents data is transmitted or received between a plurality of transmission terminals through relay devices, there is a video conference system in which a video conference takes place via a communication network such as the Internet. Recently, the need for a video conference system is growing because of a tendency of saving expenses and time for business trips. In the video conference system, a plurality of video conference terminals are used as an example of the transmission terminals. The video conference can be made by reception and transmission of image data and voice data between the video conference terminals.

Further, the recent enhancement of the broadband environment made it possible to transmit and receive high-quality image data and high-quality voice data. Thus, a situation of the other party of the video conference is easily recognized, which leads to improved fidelity of communication.

However, when a large number of video conferences are conducted via the communication network or when the image data or the voice data is received through the narrowband channel on the communication network, the image data or the voice data may be delayed. If the image data or the voice data is delayed by 0.5 seconds or more, it is reported that the user of the video conference feels stress during the conversation. Thus, in spite of the recent enhancement of the broadband environment, it happens sometimes that the user cannot perform the satisfactory video conference.

In recent years, in connection with the video conference system, relay devices that relay the image data and the voice data between the video conference terminals are installed for every local area network (LAN) in the communication network. When the video conference communication process is performed in distributed manner through these relay devices, a load on each relay device can be reduced and a data transmission amount of the image data or the voice data to be relayed can be distributed.

Conventionally, in selecting and using one relay device from among a plurality of relay devices, a relay device on the same LAN as the video conference terminal that participates in the video conference, was used. That is, by selecting a relay device having an IP address close to an IP address of the video conference terminal, transmission and reception of the high-quality image data is enabled through the selected relay device (see Japanese Patent Application Laid-open No. 2008-227577).

However, in the conventional video conference system, the relay device is selected under the presumption that the high-quality image data or the high-quality voice data can be transmitted and received if the relay device having the IP address close to the IP address of the video conference terminal is used. Thus, it may not well-suited for the actual communication network environment. For example, even if the IP address of the video conference terminal and the IP address of the relay device are obtained in advance, since it is difficult to grasp access states of all communication networks in the world, the presumption is not always correct. For example, there may be disconnections in actual environment. Therefore, it is difficult to transmit and receive the image data or the voice data of as high quality as possible under the actual communication network environment.

DISCLOSURE OF INVENTION

According to one aspect of the present invention, there is provided a transmission management system that provides a support of finally narrowing relay devices, which relay at least one of image data and voice data to be communicated between a plurality of transmission terminals via a communication network, down to one relay device, the system including: a relay device management unit that manages relay device-specifying information representing an IP address used to specify each of the relay devices on the communication network or a fully qualified domain name (FQDN) corresponding to the IP address, for every piece of relay device identification information for identifying each of the relay devices; a terminal management unit that manages terminal-specifying information representing an IP address used to specify each of the transmission terminals on the communication network or a FQDN corresponding to the IP address, for every piece of terminal identification information for identifying each of the transmission terminals; an identification information receiving unit that receives, from a transmission terminal as a predetermined request source, terminal identification information for identifying the transmission terminal as the request source and terminal identification information for identifying a transmission terminal as a destination; an extracting unit that extracts the terminal-specifying information of a corresponding transmission terminal of the transmission terminals by searching the terminal management unit based on at least one of the terminal identification information for identifying the request source and the terminal identification information for identifying the destination; and a primary selecting unit that searches the relay device management unit based on an IP address represented by the extracted terminal-specifying information or an IP address corresponding to a FQDN represented by the extracted terminal-specifying information to select two or more pieces of relay device identification information of two or more of the relay devices, to which relay device-specifying information representing top two or more IP addresses closest to the IP address represented by the extracted terminal-specifying information or the IP address corresponding to the FQDN represented by the extracted terminal-specifying information or representing FQDNs corresponding to the top two or more

IP addresses, is allocated, so that a primary narrowing process is performed before finally narrowing the relay devices down to one relay device.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a schematic diagram of a transmission system according to a first exemplary embodiment of the present invention.

FIG. **2** is a conceptual diagram illustrating a transmission/reception state of image data, voice data, and a variety of management information in a transmission system.

FIGS. **3**A to **3**C are conceptual diagrams for explaining image quality of image data.

FIG. **4** is an external view of a terminal according to the present exemplary embodiment.

FIG. **5** is a diagram illustrating a hardware configuration of the terminal according to the present exemplary embodiment.

FIG. **6** is a diagram illustrating a hardware configuration of a management system, a relay device, and a program providing system according to the present exemplary embodiment.

FIG. **7** is a functional block diagram of the terminal, the relay device, and the management system that constitute the transmission system according to the present exemplary embodiment.

FIG. **8** is a functional configuration diagram of a final narrowing unit.

FIG. **9** is a functional configuration diagram of a primary narrowing unit.

FIG. **10** is a conceptual diagram illustrating a quality change management table.

FIG. **11** is a conceptual diagram illustrating a relay device management table.

FIG. **12** is a conceptual diagram illustrating a terminal authentication management table.

FIG. **13** is a conceptual diagram illustrating a terminal management table.

FIG. **14** is a conceptual diagram illustrating a destination list management table.

FIG. **15** is a conceptual diagram illustrating a session management table.

FIG. **16** is a conceptual diagram illustrating an address priority management table.

FIG. **17** is a conceptual diagram illustrating a transmission rate priority management table.

FIG. **18** is a conceptual diagram illustrating a quality management table.

FIG. **19** is a sequence diagram illustrating a process of managing state information representing an operation state of each relay device.

FIG. **20** is a sequence diagram illustrating a process of a preparation step of starting a remote communication between the terminals.

FIG. **21** is a sequence diagram illustrating a process of narrowing down the relay devices.

FIG. **22** is a flowchart illustrating a process of narrowing down the relay devices.

FIG. **23** is a diagram illustrating a point calculation state when performing a process of narrowing down the relay devices.

FIG. **24** is a sequence diagram illustrating a process of selecting a relay device at a transmission terminal according to the first exemplary embodiment of the present invention.

FIG. **25** is a flowchart illustrating a process of selecting a relay device at a transmission terminal.

FIG. **26** is a sequence diagram illustrating a process of transmitting and receiving image data and voice data between the transmission terminals.

FIG. **27** is a sequence diagram illustrating a process of selecting a relay device at a transmission terminal according to a second exemplary embodiment of the present invention.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

Hereinafter, exemplary embodiments of the present invention will be described with reference to the accompanying drawings.

First Embodiment

Hereinafter, a first exemplary embodiment of the present invention will be described with reference to FIGS. **1** to **26**.

The Entire Configuration of the Exemplary Embodiment

FIG. **1** is a schematic diagram of a transmission system **1** according to the present exemplary embodiment of the present invention. FIG. **2** is a conceptual diagram illustrating a transmission/reception state of image data, voice data, and a variety of management information in a transmission system. FIGS. **3**A to **3**C are conceptual diagrams for explaining the image quality of image data.

The transmission system includes a data providing system that transmits contents data in one direction from one transmission terminal to another transmission terminal through a transmission management system and a communication system that transmits information or a feeling between a plurality of transmission terminals through the transmission management system. The communication system refers to a system that transmits information or a feeling between a plurality of communication terminals (corresponding to the "transmission terminals") through the communication management system (corresponding to the "transmission management system"). Examples of the communication system include a video conference system and a television telephone system.

In the present exemplary embodiment, the transmission system, the transmission management system, and the transmission terminal will be described under the assumption that a video conference system is used as an example of the communication system, a video conference management system is used as an example of the communication management system, and video conference terminals are used as an example of the communication terminals. That is, the transmission terminal and the transmission management system of the present invention are applied not only to the video conference system but also to the communication system or the transmission system.

First, a transmission system illustrated in FIG. **1** includes a plurality of transmission terminals **10***aa*, **10***ab*, . . . , displays **120***aa*, **120***ab*, . . . , for the transmission terminals **10***aa*, **10***ab*, . . . , respectively, a plurality of relay devices **30***a*, **30***b*, **30***c*, and **30***d*, a transmission management system **50**, a program providing system **90**, and a maintenance system **100**.

The plurality of terminals **10** performs transmission based on transmission or reception of image data and voice data as an example of contents data.

Hereinafter, the "transmission terminal" is referred to as simply a "terminal," and the "transmission management system" is referred to as simply a "management system." An arbitrary terminal among the plurality of terminals **10***aa*, **10***ab*, . . . , is referred to as a "terminal **10**," and an arbitrary display among the plurality of displays **120***aa*, **120***ab*, . . . , is referred to as a "display **120**." An arbitrary relay device

among the plurality of relay devices **30***a*, **30***b*, **30***c*, and **30***d* is referred to as a "relay device **30**." A terminal that is a request source that requests the start of the video conference is referred to as a "request source terminal." A terminal that is a destination (a relay destination) serving as a request destination is referred to as a "destination terminal."

As illustrated in FIG. **2**, in the transmission system **1**, a management information session sei for transmitting and receiving a variety of management information is established between the request source terminal and the destination terminal through a management system **50**. Four sessions for transmitting and receiving four items of data including high-resolution image data, intermediate-resolution image data, low-resolution image data, and voice data, respectively, are established between the request source terminal and the destination terminal through the relay device **30**. The four sessions are collectively designated as an image/voice data session sed.

The image resolution of the image data dealt with in the present exemplary embodiment will be described. There are a low-resolution image that includes 160×120 pixels and is a base image as illustrated in FIG. **3**A, an intermediate-resolution image that includes 320×240 pixels as illustrated in FIG. **3**B, and a high-resolution image that includes 640×480 pixels as illustrated in FIG. **3**C. Of these, if a narrow band is used, the low-quality image data including only the low-resolution image data that is the base image is relayed. If a relatively broad band is used, the intermediate-quality image data including the low-resolution image data that is the base image and the intermediate-resolution image data is relayed. If a very broad band is used, the high-quality image data including the low-resolution image data that is the base image, the intermediate-resolution image data, and the high-resolution image data is relayed.

The relay device **30** illustrated in FIG. **1** relays the contents data between a plurality of terminals. The management system **50** performs management on login authentication of the terminal **10**, a call state of the terminal **10**, and a destination list, and a communication state of the relay device **30** in an integrated fashion. The image of the image data may include either or both of a moving picture and a still picture.

A plurality of routers **70***a*, **70***b*, **70***c*, **70***d*, **70***ab*, and **70***cd* selects an optimum channel of the image data and the voice data. Hereinafter, an arbitrary router among the routers **70***a*, **70***b*, **70***c*, **70***d*, **70***ab*, and **70***cd* is referred to as a "router **70**."

The program providing system **90** includes a hard disk (HD) which will be described later. The program providing system **90** stores a terminal program for implementing a variety of functions in the terminal **10** (or for causing the terminal **10** to function as a variety of means) and transmits the terminal program to the terminal **10**. A hard disk **204** of the program providing system **90** stores a relay device program for implementing a variety of functions in the relay device **30** (or for causing the relay device **30** to function as a variety of means) and transmits the relay device program to the relay device **30**. The hard disk **204** of the program providing system **90** also stores a transmission management program for implementing a variety of functions in the management system **50** (or for causing the management system **50** to function as a variety of means) and transmits the transmission management program to the management system **50**.

The maintenance system **100** is a computer for performing the maintenance, management, and a repair on at least one of the terminal **10**, the relay device **30**, the management system **50**, and the program providing system **90**. For example, if the maintenance system **100** is installed domestically, and the terminal **10**, the relay device **30**, the management system **50**, or the program providing system **90** is installed overseas, the maintenance system **100** remotely performs a maintenance work such as the maintenance, the management, and the repair on at least one of the terminal **10**, the relay device **30**, the management system **50**, and the program providing system **90** via a communication network **2**. The maintenance system **100** also performs a maintenance work such as management of a model number, a manufacturing number, a sale destination, a repair check, or a failure history in at least one of the terminal **10**, the relay device **30**, the management system **50**, and the program providing system **90** without involving the communication network **2**.

The terminals **10***aa*, **10***ab*, **10***ac*, . . . , the relay device **30***a*, and the router **70***a* are connected via a LAN **2***a* to mutually perform communications. The terminals **10***ba*, **10***bb*, **10***bc*, . . . , the relay device **30***b*, and the router **70***b* are connected via a LAN **2***b* to mutually perform communications. The LAN **2***a* and the LAN **2***b* are connected to each other by a dedicated line **2***ab* including the router **70***ab* and constructed within a predetermined area A. For example, the area A is Japan, the LAN **2***a* is constructed within a business office in Tokyo, and the LAN **2***b* is constructed within a business office in Osaka.

The terminals **10***ca*, **10***cb*, **10***cc*, . . . , the relay device **30***c*, and the router **70***c* are connected via a LAN **2***c* to mutually perform communications. The terminals **10***da*, **10***db*, **10***dc*, . . . , the relay device **30***d*, and the router **70***d* are connected via a LAN **2***d* to mutually perform communications. The LAN **2***c* and the LAN **2***d* are connected to each other by a dedicated line **2***cd* including the router **70***cd* and constructed within a predetermined area B. For example, the area B is the United States of America (USA), the LAN **2***c* is constructed within a business office in New York, and the LAN **2***d* is constructed within a business office in Washington. The area A and the area B are connected to each other to perform communications through the routers **70***ab* and **70***cd* via the Internet **2***i*.

The management system **50** and the program providing system **90** are connected to perform communications with the terminal **10** and the relay device **30** via the Internet **2***i*. The management system **50** and the program providing system **90** may be installed in the area A, the area B, or any other area.

In the present exemplary embodiment, the communication network **2** of the present exemplary embodiment is constructed by the LAN **2***a*, the LAN **2***b*, the dedicated line **2***ab*, the Internet **2***i*, the dedicated line **2***cd*, the LAN **2***c*, and the LAN **2***d*. The communication network **2** is not limited to wire-line communication but may have a site where wireless communication such as wireless fidelity (WiFi) or Bluetooth (a registered trademark) is performed.

In FIG. **1**, four-set numbers indicated below each terminal **10**, each relay device **30**, the management system **50**, each router **70**, and the program providing system **90** simply represent typical IP addresses in the IPv4. For example, the IP address of the terminal **10***aa* is "1.2.1.3." The IPv6 may be used instead of the IPv4, but for simplification of the description, a description will be made in connection with the IPv4.

Each of the terminals **10** may be used for a call in the same room, a call between the indoor and the outdoor, and a call between the outdoor and the outdoor as well as a call between a plurality of business offices and a call between different rooms within the same business office. When each of the terminals **10** is used outdoor, wireless communication is performed through a cellular phone communication network.

A Hardware Configuration of the Exemplary Embodiment

Next, a hardware configuration of an exemplary embodiment will be described. The present exemplary embodiment

is described in connection with a case in which if a delay occurs when the terminal **10** as a destination (a relay destination) receives the image data, the image resolution of the image data is changed by the relay device **30**, and then the image data is transmitted to the terminal **10** as the relay destination.

FIG. **4** is a diagram illustrating the appearance of a terminal according to the present exemplary embodiment. As illustrated in FIG. **4**, the terminal **10** includes a case **1021**, an arm **1074**, and a camera housing **1075**. A plurality of intake holes **1021***e* is formed in nearly the whole surface of a front sidewall **1021***a* of the case **1021**, and a plurality of exhaust holes (not shown) is formed in nearly the whole surface of a rear sidewall **1021***b* of the case **1021**. As a cooling fan disposed in the case **1021** is driven, the outside air in front of the terminal **10** is taken in through the intake holes **1021***e* and exhausted through the back of the terminal **10** through the exhaust holes. A sound absorption hole **1021***f* is formed in the center of the front sidewall **1021***a*, and a sound such as a voice, and a noise is absorbed by a built-in microphone which will be described later.

When the case **1021** is viewed from the front, an operation panel **1022** is formed on the left. On the operation panel **1022**, an operation button **108** which will be described later and a power switch **109** which will be described later are disposed, and a plurality of voice output holes **1022***f* for allowing a sound output from a built-in speaker **115** which will be described later to pass is formed. Further, when the case **1021** is viewed from the front, an accommodation section **1021***p* serving as a concave portion for accommodating the arm **1074** and the camera housing **1075** is formed on the right.

The arm **1074** is mounted onto the case **1021** through a torque hinge **1073**. The arm **1074** is rotatable on the case **1021** in an up/down or left/right direction in a range of a pan angle θ**1** of ±180° and a range of a tilt angle θ**2** of 90° (a click feeling is generated when tilted at an angle of about 45°) if it is assumed that the front is 0°.

A built-in camera **112** which will be described later is disposed in the camera housing **1075** and captures an image of a user or a room. A torque hinge **1075***a* is formed in the camera housing **1075**. The camera housing **1075** is mounted onto the arm **1074** through the torque hinge **1075***a*. If it is assumed that a state in which the camera housing **1075** forms a straight line with the arm **1074** is 0°, the camera housing **1075** is rotatable in a range of a tilt angle θ**3** of about 100° in the front side of the terminal **10** and about 90° in the back side of the terminal **10**.

The relay device **30**, the management system **50**, and the program providing system **90** have the same appearance as a general server or computer, respectively, and thus a description thereof will be omitted.

FIG. **5** is a diagram illustrating hardware configuration of the terminal **10** according to the present exemplary embodiment of the present invention. As illustrated in FIG. **5**, the terminal **10** includes a central processing unit (CPU) **101** that controls an overall operation of the terminal **10**, a read only memory (ROM) **102** that stores a program, used for driving of the CPU **101**, such as an initial program loader (IPL), a random access memory (RAM) **103** used as a work area of the CPU **101**, a flash memory **104** that stores a variety of data such as the terminal program, the image data, and the voice data, a solid state drive (SSD) **105** that reads or writes a variety of data from or in the flash memory **104** under control of the CPU **101**, a media drive **107** that controls reading or writing (storing) of data from or to a recording media **106** such as a flash memory, an operation button **108** operated when selecting a destination of the terminal **10**, a power switch **109** for switching ON/OFF of power of the terminal **10**, and a network interface (I/F) **111** for performing data transmission via the communication network **2**.

The terminal **10** further includes the built-in camera **112** that captures an image of a subject under control of the CPU **101**, an image capturing device I/F **113** that controls driving of the camera **112**, a built-in microphone **114** that receives a voice, the built-in speaker **115** that outputs a voice, a voice I/O I/F **116** that processes an input and output of a voice signal between the microphone **114** and the speaker **115** under control of the CPU **101**, a display I/F **117** that transmits the image data to a display **120** mounted to the outside thereof under control of the CPU **101**, and an external device connection I/F **118** that is connected with a variety of external devices, and a bus line **110** such as an address bus or a data bus that electrically connects the above-mentioned components as illustrated in FIG. **5**.

The display **120** is a display unit configured with a liquid crystal or an organic EL that displays an image of a subject or an operation icon. The display **120** is connected with the display I/F **117** through a cable **120***c*. As the cable **120***c*, a cable for an analog RGB (VGA) signal, a cable for a component video, or a cable for a high-definition multimedia interface (HDMI) or digital video interactive (DVI) signal may be used.

The camera **112** includes a lens and a solid-state image sensing device that digitizes an image (a video) of a subject by converting light into an electrical charge. As the solid state image sensing device, a complementary metal oxide semiconductor (CMOS) or a charge coupled device (CCD) is used.

An external device such as an external camera, an external microphone, and an external speaker may be connected to the external device connection I/F **118** through a universal serial bus (USB). When the external camera is connected, the external camera is driven prior to the built-in camera **112** under control of the CPU **101**. Similarly, when the external microphone is connected or when the external speaker is connected, the external microphone or the external speaker is driven prior to the built-in microphone **114** or the built-in speaker **115** under control of the CPU **101**.

The recording media **106** is configured to be removal from the terminal **10**. A non-volatile memory in which reading or writing of data is performed under control of the CPU **101** is not limited to the flash memory **104**, and an electrically erasable and programmable ROM (EEPROM) may be used.

The terminal program is a file having an installable format or an executable format. The terminal program may be distributed in the form recorded on a computer readable recording medium such as the recording medium **106**. The terminal program may be stored in the ROM **102** other than the flash memory **104**.

FIG. **6** is a hardware configuration diagram of the management system according to the embodiment of the present invention. As shown in FIG. **6**, the management system **50** includes: a CPU **201** that controls an overall operation of the management system **50**; a ROM **202** that stores a program, used for driving of the CPU **201**, such as an IPL; a RAM **203** used as a working area of the CPU **201**, the hard disk (HD) **204** that stores a variety of data such as a transmission management program; a hard disk drive (HDD) **205** that controls reading or writing of various data to or from the HD **204** under control of the CPU **201**; a media drive **207** that controls reading or writing (storing) of data from or to a recording media **206** such as a flash memory; a display **208** that displays various information such as a cursor, a menu, a window, a character, and an image; a network I/F **209** for performing data transmission via the communication network **2**; a key-

board **211** that includes a plurality of keys for inputting a character, a numerical number, and a variety of instructions; a mouse **212** that performs selection or execution of a variety of instructions, selection of a processing target, and movement of a cursor; a compact disc-read only memory (CD-ROM) drive **214** that controls reading or writing of various data from or to a CD-ROM **213** as a removable recording medium; and a bus line **210** such as an address bus or a data bus for electrically connecting the above-mentioned components.

The transmission management program is a file having an installable format or an executable format. The transmission management program may be distributed in the form recorded on a computer readable recording medium such as the recording medium **206** or the CD-ROM **213**. The transmission management program may be stored in the ROM **202** other than the HD **204**.

The relay device **30** has a similar configuration to the management system **50**, and thus a description thereof will not be repeated. However, a relay device program for controlling the relay device **30** is recorded in the HD **204**. Even in this case, the relay device program is a file having an installable format or an executable format. The relay device program may be distributed in the form recorded on a computer readable recording medium such as the recording medium **206** or the CD-ROM **213**. The relay device program may be stored in the ROM **202** other than the HD **204**.

The program providing system **90** and the maintenance system **100** have a similar configuration to the management system **50**, and thus a description thereof will not be repeated. However, a program for the program providing system for controlling the program providing system **90** is recorded in the HD **204**. Even in this case, the program for the program providing system is a file having an installable format or an executable format, and may be distributed in the form recorded on a computer readable recording medium such as the recording medium **206** or the CD-ROM **213**. A program for the program providing system may be stored in the ROM **202** other than the HD **204**.

As another example of the removable recording medium, there may be provided a computer readable recording medium such as a compact disc-recordable (CD-R), a digital versatile disk (DVD), and a Blu-ray disc for recording and providing the programs.

A Functional Configuration of the Exemplary Embodiment

Next, a functional configuration of the present exemplary embodiment will be described. FIG. **7** is a functional block diagram of each terminal, the device, and the system that constitute the transmission system **1** according to the present exemplary embodiment. In FIG. **7**, the terminal **10**, the relay device **30**, and the management system **50** are connected to perform communications via the communication network **2**. The program providing system **90** illustrated in FIG. **1** has nothing to do directly with video conference communication and thus, an illustration thereof is omitted in FIG. **7**.

A Functional Configuration of the Terminal

The terminal **10** includes a transceiving unit **11**, an operation input receiving unit **12**, a login requesting unit **13**, an image capturing unit **14**, a voice input unit **15***a*, a voice output unit **15***b*, a final narrowing unit **16**, a display control unit **17**, a delay detecting unit **18**, and a storing/reading process unit **19**. Each of the components performs a function that is executed or serves as a means that operates such that any one of the components illustrated in FIG. **5** operates in response to a command from the CPU **101** according to the terminal program loaded onto the RAM **103** from the flash memory **104**. The terminal **10** further includes a storage unit **1000** constructed by the RAM **103** illustrated in FIG. **5** and the flash memory **104** illustrated in FIG. **5**.

Each Functional Configuration of the Terminal

Next, each functional configuration of the terminal **10** will be described in detail with reference to FIGS. **5** and **7**. A description of each functional configuration of the terminal **10** will be made below in connection with a relationship with major components for implementing each functional configuration of the terminal among the components illustrated in FIG. **5**.

The transceiving unit **11** of the terminal **10** illustrated in FIG. **5** is implemented by a command from the CPU **101** illustrated in FIG. **5** and the network I/F **111** illustrated in FIG. **5** and performs exchange of various data (or information) with another terminal, the device or the system via the communication network **2**. Before initiating a call with a desired destination terminal, the transceiving unit **11** initiates reception of each piece of state information representing a state of each terminal as a destination candidate from the management system **50**. The state information represents not only an operation state (an on-line or off-line state) of each terminal but also a detailed state such as whether each terminal **10** is in a call enable state, in a busy state, or in a user absence state even when it is in the on-line state. Further, the state information represents not only the operation state of each terminal **10** but also various states such as a state in which the cable **120***c* is removed from the terminal **10**, a state in which a voice is output but an image is not output, or a state (a mute state) in which a voice is not output. Hereinafter, as an example, a case in which the state information represents the operation state will be described.

The operation input receiving unit **12** is implemented by a command from the CPU **101** illustrated in FIG. **5**, and the operation button **108** and the power switch **109** that are illustrated in FIG. **5** and receives various inputs from the user. For example, if the user turns on the power switch **109** illustrated in FIG. **5**, the operation input receiving unit **12** illustrated in FIG. **7** receives power ON and turns on the power.

The login requesting unit **13** is implemented by a command from the CPU **101** illustrated in FIG. **5**. The login requesting unit **13** automatically transmits login request information representing a login request and a present IP address of a request source terminal from the transceiving unit **11** to the management system **50** via the communication network **2** when the power ON is received. If the user switches the power switch **109** from the ON state to the OFF state, after the transceiving unit **11** transmits the state information representing power OFF to the management system **50**, the operation input receiving unit **12** completely turns off the power. Thus, the management system **50** side can recognize that the power of the terminal **10** was switched from ON to OFF.

The image capturing unit **14** is implemented by a command from the CPU **101** illustrated in FIG. **5**, and the camera **112** and the image capturing device I/F **113** that are illustrated in FIG. **5**. The image capturing unit **14** captures an image of a subject and outputs image data obtained by capturing the image.

The voice input unit **15***a* is implemented by a command from the CPU **101** illustrated in FIG. **5** and the voice I/O I/F **116** illustrated in FIG. **5**. The voice input unit **15***a* receives voice data related to a voice signal obtained by converting a voice of the user through the microphone **114**. The voice output unit **15***b* is implemented by a command from the CPU **101** illustrated in FIG. **5** and the voice I/O I/F **116** illustrated in FIG. **5**. The voice output unit **15***b* outputs a voice signal related to voice data to the speaker, so that a voice is output from the speaker.

The final narrowing unit **16** implements a measuring unit **16***a*, a calculating unit **16***b*, and a final selecting unit **16***c*, which are illustrated in FIG. **8**, based on a command from the CPU **101** illustrated in FIG. **5** in order to perform a final narrowing process for finally narrowing the plurality of relay devices **30** down to one relay device **30**.

Of these, the measuring unit **16***a* measures reception date and time in which prior transmission information, which will be described later, is received by the transceiving unit **11** for each piece of the prior transmission information received by the transceiving unit **11**. The calculating unit **16***b* calculates a required time T between transmission and reception of the prior transmission information, for each piece of the prior transmission information in which the reception date and time was measured by the measuring unit **16***a*, based on a difference between the measured reception time and a transmission time included in the prior transmission information. The final selecting unit **16***c* finally selects one relay device by selecting the relay device **30** that relayed the prior transmission information having the shortest required time among the required times calculated by the calculating unit **16***b*.

The display control unit **17** is implemented by a command from the CPU **101** illustrated in FIG. **5** and the display I/F **117** illustrated in FIG. **5**. The display control unit **17** performs control for combining received image data having different resolutions as will be described later and transmitting the combined image data to the display **120**. The display control unit **17** transmits destination list information received from the management system **50** to the display **120** so that the destination list can be displayed on the display **120**.

The delay detecting unit **18** is implemented by a command from the CPU **101** illustrated in FIG. **5**. The delay detecting unit **18** detects a delay time (ms) of the image data or voice data transmitted from another terminal **10** through the relay device **30**.

The storing/reading process unit **19** is implemented by a command from the CPU **101** illustrated in FIG. **5** and the SSD **105** illustrated in FIG. **5** or implemented by a command from the CPU **101**. The storing/reading process unit **19** performs a process of storing various data in the storage unit **1000** or reading various data stored in the storage unit **1000**. A terminal identification (ID) for identifying the terminal **10** and a password are stored in the storage unit **1000**. Further, the image data and voice data received while performing a call with a destination terminal are stored in the storage unit **1000** in an overwriting manner at each time of reception. At this time, an image is displayed on the display **120** based on the image data that is not overwritten yet, and a voice is output from a speaker **150** based on the voice data that is not overwritten yet.

The terminal ID and a relay device ID which will be described later according to the present exemplary embodiment represent identification information such as a language, a character, a symbol, or various marks used for uniquely identifying each terminal **10** and each relay device **30**, respectively. The terminal ID and the relay device ID may include identification information in which at least two of the language, the character, the symbol, and the various marks are combined.

A Functional Configuration of the Relay Device

The relay device **30** includes a transceiving unit **31**, a state detecting unit **32**, a data quality confirming unit **33**, a quality change managing unit **34**, a data quality changing unit **35**, and a storing/reading process unit **39**. Each of the components performs a function that is executed or serves as a means that operates such that any one of the components illustrated in FIG. **6** operates in response to a command from the CPU **201** based on the relay device program loaded onto the RAM **203** from the HD **204**. The relay device **30** further includes a storage unit **3000** constructed by the RAM **203** illustrated in FIG. **6** and/or the HD **204** illustrated in FIG. **6**.

A Quality Change Management Table

A quality change management database (DB) **3001** configured with a quality change management table illustrated in FIG. **10** is constructed in the storage unit **3000**. In the quality change management table, the IP address of the terminal **10** as the relay destination of the image data is managed in association with the image quality of the image data to be relayed to the relay destination by the relay device **30**.

Each Functional Configuration of the Relay Device

Next, each functional configuration of the relay device **30** will be described in detail. A description of each functional configuration of the relay device **30** will be made below in connection with a relationship with major components for implementing each functional configuration of the relay device **30** among the components illustrated in FIG. **6**.

The transceiving unit **31** of the relay device **30** illustrated in FIG. **7** is implemented by a command from the CPU **201** illustrated in FIG. **6** and the network I/F **209** illustrated in FIG. **6** and performs exchange of various data (or information) with another terminal, the device or the system via the communication network **2**.

The state detecting unit **32** is implemented by a command from the CPU **201** illustrated in FIG. **6** and detects the operation state of the relay device **30** having the state detecting unit **32**. The operation state may include a "one-line" state, an "off-line" state, a "busy" state, and a "temporary halt" state.

The data quality confirming unit **33** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The data quality confirming unit **33** confirms the image quality of the image data to be relayed by retrieving the quality change management DB **3001** (see FIG. **10**) by using the IP address of the destination terminal as a retrieval key and extracting the image quality of the corresponding image data to be relayed.

The quality change managing unit **34** is implemented by a command from the CPU **201** illustrated in FIG. **6** and changes the content of the quality change management DB **3001** based on quality information, which will be described later, transmitted from the management system **50**. For example, while the video conference is being held by transmitting and receiving the high-quality image data between the request source terminal (the terminal **10***aa*) having "01aa" as the terminal ID and the destination terminal (the terminal **10***db*) having "01db" as the terminal ID, if a delay occurs when the destination terminal (the terminal **10***db*) receives the image data because the request source terminal (the terminal **10***bb*) and the destination terminal (the terminal **10***ca*) that perform another video conference start the video conference via the communication network **2**, the relay device **30** lowers the image quality of the image data that has been relayed so far from the high image quality to the intermediate image quality. In this case, the content of the quality change management DB **3001** is changed, based on the quality information representing the intermediate image quality, to lower the image quality of the image data to be relayed by the relay device **30** from the high image quality to the intermediate image quality.

The data quality changing unit **35** is implemented by a command from the CPU **201** illustrated in FIG. **6** and changes the image quality of the image data transmitted from the transmission source terminal based on the changed content of the quality change management DB **3001**.

The storing/reading process unit **39** is implemented by a command from the CPU **201** illustrated in FIG. **6** and the HDD **205** illustrated in FIG. **6**. The storing/reading process

unit **39** performs a process of storing various data in the storage unit **3000** or reading various data stored in the storage unit **3000**.

A Functional Configuration of the Management System

The management system **50** includes a transceiving unit **51**, a terminal authenticating unit **52**, a state managing unit **53**, a terminal extracting unit **54**, a terminal state acquiring unit **55**, a primary narrowing unit **56**, a session managing unit **57**, a quality deciding unit **58**, a storing/reading process unit **59**, and a delay time managing unit **60**. Each of the components performs a function that is executed or serves as a means that operates such that any one of the components illustrated in FIG. **6** operates in response to a command from the CPU **201** based on the management system program loaded onto the RAM **203** from the HD **204**. The management system **50** further includes a storage unit **5000** constructed by the HD **204** illustrated in FIG. **6**.

A Relay Device Management Table

A relay device management DB **5001** configured with a relay device management table illustrated in FIG. **11** is constructed in the storage unit **5000**. In the relay device management table, the operation state of each relay device **30**, the reception date and time in which the state information representing the operation state is received by the management system **50**, the IP address of the relay device **30**, and a maximum data transmission rate Mbps in the relay device **30** are managed in association with the relay device ID of each relay device **30**. For example, the relay device management table illustrated in FIG. **11** represents that the operation state of the relay device **30***a* having "111a" as the relay device ID is "on-line," the date and time in which the state information was received by the management system **50** is "13:00, November 10, 2009," the IP address of the relay device **30***a* is "1.2.1.2," and the maximum data transmission rate in the relay device **30***a* is 100 Mbps.

A Terminal Authentication Management Table

Further, a terminal authentication management DB **5002** configured with a terminal authentication management table illustrated in FIG. **12** is constructed in the storage unit **5000**. In the terminal authentication management table, a password is managed in association with a terminal ID for each of the terminals **10** managed by the management system **50**. For example, the terminal authentication management table illustrated in FIG. **2** represents that the terminal ID of the terminal **10***aa* is "01aa," and the password is "aaaa."

A Terminal Management Table

A terminal management DB **5003** configured with a terminal management table illustrated in FIG. **13** is constructed in the storage unit **5000**. In the terminal management table, a destination name in which each terminal **10** is a destination, the operation state of each terminal **10**, the reception date and time in which login request information which will be described later is received by the management system **50**, and the IP address of the terminal **10** are managed in association with the terminal ID of each of the terminals **10**. For example, the terminal management table illustrated in FIG. **13** represents that the terminal name of the terminal **10***aa* having "01aa" as the terminal ID is an "AA terminal of a Tokyo office in Japan," the operation state is "on-line (call enable)," the date and time in which the login request information was received by the management system **50** is "13:40, November 10, 2009," and the IP address of the terminal **10***aa* is "1.2.1.3."

A Destination List Management Table

Further, a destination list management DB **5004** configured with a destination list management table illustrated in FIG. **14** is constructed in the storage unit **5000**. In the destination list management table, the terminal IDs of all the destination terminals registered as the candidate of the destination terminal are managed in association with the terminal ID of the request source terminal that requests the start of a call in the video conference. For example, the destination list management table illustrated in FIG. **14** represents that the candidate of the destination terminal (the terminal **10***db*) to which the request source terminal (the terminal **10***aa*) having "01aa" as the terminal ID can requests the start of a call in the video conference includes the terminal **10***ab* having "01ab" as the terminal ID, the terminal **10***ba* having "01ba" as the terminal ID, the terminal **10***bb* having "01bb" as the terminal ID, etc. The candidate of the destination terminal is updated in a manner that the candidate of the destination terminal is added or deleted by an addition or deletion request transmitted from an arbitrary request source terminal to the management system **50**.

A Session Management Table

Further, a session management DB **5005** configured with a session management table illustrated in FIG. **15** is constructed in the storage unit **5000**. In the session management table, the relay device ID of the relay device **30** used for a relay of the image data and the voice data, the terminal ID of the request source terminal, the terminal ID of the destination terminal, the reception delay time ms occurred when the image data is received by the destination terminal, and the reception date and time in which the delay information representing the delay time is transmitted from the destination terminal and received by the management system **50** are managed in association with a selection session ID used for execution of a session for selecting the relay device **30**. For example, the session management table illustrated in FIG. **15** represents that the relay device **30***a* (the relay device ID "111a") selected through the session executed by using the selection session ID "se1" relays the image data and the voice data between the request source terminal (the terminal **10***aa*) having "01aa" as the terminal ID and the destination terminal (the terminal **10***db*) having "01db" as the terminal ID, and the delay time of the image data at a point in time of "14:00, November 10, 2009" in the destination terminal (the terminal **10***db*) is 200 ms. Further, when the video conference is held between the two terminals **10**, the reception date and time of the delay information may be managed based on the delay information transmitted from the request source terminal other than the destination terminal. Further, when the video conference is held among the three terminals **10**, the reception date and time of the delay information may be managed based on the delay information transmitted from the terminal **10** at the receiving side of the image data and the voice data.

An Address Priority Management Table

Further, a priority management DB **5006** configured with an address priority management table illustrated in FIG. **16** is constructed in the storage unit **5000**. In the address priority management table, whether or not the dot addresses in an arbitrary terminal **10** is the same as or different from the dot address in an arbitrary relay device **30** is managed in association with an address priority such that the more the number of "same" in a four-set dot address part of a typical IP address in the IPv4 is, the higher the point of the address priority is. The "same" means that the dot address parts are the same as each other, and the "different" means that the dot address parts are different from each other. For example, in the address priority management table illustrated in FIG. **16**, in the case of the IP address in which three values are same from a high-order dot address to a low-order dot address, the point of the address priority is "5." In the case of the IP address in which two values are same from the high-order dot address to the low-order dot address, the point of the address priority is "3." In

this case, whether or not the value of the least significant dot address is same has nothing to do with the priority. In the case of the IP address in which the value of the most significant dot address is same, and the second value from the high order is different, the point of the address priority is "1." In this case, whether or not the third value from the high order and the value of the least significant dot address are same has nothing to do with the priority. In the case of the IP address in which the value of the most significant dot address is different, the point of the address priority is "0." In this case, whether or not the second value and the third value from the high order and the value of the least significant dot address are same has nothing to do with the priority.

A Transmission Rate Priority Management Table

Further, a transmission rate priority management table illustrated in FIG. **17** is included in the priority management DB **5006** constructed in the storage unit **5000**. In the transmission rate priority management table, a maximum data transmission rate and a transmission rate priority are managed in association with each other such that the higher the value of the maximum data transmission rate Mbps is, the higher the point of the transmission rate priority is. For example, in the transmission rate priority management table illustrated in FIG. **17**, when the maximum data transmission rate in the relay device **30** is 1000 Mbps, the point of the transmission rate priority is "5." When the maximum data transmission rate in the relay device **30** is equal to or more than 100 Mbps and less than 1000 Mbps, the point of the transmission rate priority is "3." When the maximum data transmission rate in the relay device **30** is equal to or more than 10 Mbps and less than 100 Mbps, the point of the transmission rate priority is "1." When the maximum data transmission rate in the relay device **30** is less than 10 Mbps, the point of the transmission rate priority is "0."

A Quality Management Table

Further, a quality management DB **5007** configured with a quality management table illustrated in FIG. **18** is constructed in the storage unit **5000**. In the quality management table, the delay time of the image data and the image quality of the image data (the quality of the image) are managed in association with each other such that the longer the delay time ms of the image data in the request source terminal or the destination terminal is, the lower the image quality (the quality of the image) of the image data to be relayed by the relay device **30** is.

Each Functional Configuration of the Management System

Next, each functional configuration of the management system **50** will be described in detail. Hereinafter, a description of each functional configuration of the management system will be made in connection with a relationship with major components for implementing each functional configuration of the management system **50** among the components illustrated in FIG. **6**.

The transceiving unit **51** is implemented by a command from the CPU **201** illustrated in FIG. **6** and the network I/F **209** illustrated in FIG. **6** and performs exchange of various data (or information) with another terminal, the device or the system via the communication network **2**.

The terminal authenticating unit **52** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The terminal authenticating unit **52** performs terminal authentication by retrieving the terminal authentication management DB **5002** of the storage unit **5000** by using the terminal ID and the password included in the login request information received through the transceiving unit **51** as a retrieval key and determining whether or not the same terminal ID and password are managed in the terminal authentication management DB **5002**.

The state managing unit **53** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The state managing unit **53** stores and manages the terminal ID of the request source terminal, the operation state of the request source terminal, the reception date and time in which the login request information is received by the management system **50**, and the IP address of the request source terminal in the terminal management DB **5003** (see FIG. **13**) in association with each other in order to manage the operation state of the request source terminal that requested the login. When the user switches the state of the power switch **109** of the terminal **10** from ON to OFF, the state managing unit **53** changes the operation state of the terminal management DB **5003** (see FIG. **13**) representing "on line" to "off line" based on the state information representing power OFF transmitted from the terminal **10**.

The terminal extracting unit **54** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The terminal extracting unit **54** retrieves the destination list management DB **5004** (see FIG. **14**) by using the terminal ID of the request source terminal that requested the login as a key and extracts the terminal ID by reading the terminal ID of the candidate of the destination terminal that can perform a call with the request source terminal. Further, the terminal extracting unit **54** retrieves the destination list management DB **5004** (see FIG. **14**) by using the terminal ID of the request source terminal that requested the login as a key and extracts the terminal ID of another request source terminal that registered the terminal ID of the request source terminal as the candidate of the destination terminal.

The terminal state acquiring unit **55** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The terminal state acquiring unit **55** retrieves the terminal management DB **5003** (see FIG. **13**) by using the terminal ID of the candidate of the destination terminal extracted by the terminal extracting unit **54** as a retrieval key and reads the operation state for each of the terminal IDs extracted by the terminal extracting unit **54**. Thus, the terminal state acquiring unit **55** can acquire the operation state of the candidate of the destination terminal that can perform a call with the request source terminal that requested the login. Further, the terminal state acquiring unit **55** retrieves the terminal management DB **5003** by using the terminal ID extracted by the terminal extracting unit **54** as the retrieval key and acquires the operation state of the request source terminal that requested the login.

The primary narrowing unit **56** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The primary narrowing unit **56** performs a primary narrowing process before a final narrowing process in order to support the final narrowing process for finally narrowing the plurality of relay devices **30** down to one relay device **30**. To this end, the primary narrowing unit **56** implements a selection session ID generating unit **56***a*, a terminal IP address extracting unit **56***b*, a primary selecting unit **56***c*, and a priority deciding unit **56***d* as illustrated in FIG. **9**, based on a command from the CPU **201** illustrated in FIG. **6**.

Of these, the selection session ID generating unit **56***a* generates a selection session ID used to execute the session for selecting the relay device **30**. The terminal IP address extracting unit **56***b* extracts the IP address of each corresponding terminal **10** by retrieving the terminal management DB **5003** (see FIG. **13**) based on the terminal ID of the request source terminal and the terminal ID of the destination terminal that are included in the start request information transmitted from

the request source terminal. The primary selecting unit **56***c* performs selection of the relay device **30** by selecting the relay device ID of the relay device **30** whose operation state is indicated as "on line" from among the relay devices **30** managed by the relay device management DB **5001** (see FIG. **11**).

Further, the primary selecting unit **56***c* investigates whether each of the dot addresses of the IP address of the selected relay device **30** is the same as or different from each dot address in each IP address of the request source terminal and the destination terminal by retrieving the relay device management DB **5001** (see FIG. **11**) based on the IP address of the request source terminal and the IP address of the destination terminal extracted by the terminal IP address extracting unit **56***b*. Further, the primary selecting unit **56***c* performs selection of the relay device **30** by selecting the two high-order relay devices **30** that are high in integrated point in which the point of the address priority that is higher on the terminal **10** and the point of the transmission rate priority for each relay device are integrated. Further, in the present exemplary embodiment, the two high-order relay devices **30** that are high in point are selected, but the present invention is not limited thereto. To the extent that it is possible to further narrow even one relay device **30**, three or more high-order relay devices **30** that are high in point may be selected.

The priority deciding unit **56***d* decides the point of the address priority for each of the relay device **30** investigated by the primary selecting unit **56***c* with reference to the priority management DB **5006** (see FIG. **16**). Further, the priority deciding unit **56***d* decides the point of the transmission rate priority for every relay device **30** narrowed down by the primary narrowing process performed by the primary selecting unit **56***c* by retrieving the priority management DB **5006** (see FIG. **17**) based on the maximum data transmission rate of each of the relay device **30** managed in the relay device management DB **5001** (see FIG. **11**).

Subsequently, the session managing unit **57** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The session managing unit **57** stores and manages the selection session ID generated by the selection session ID generating unit **56***a*, the terminal ID of the request source terminal, and the terminal ID of the destination terminal in the session management DB **5005** (see FIG. **15**) in association with each other. The session managing unit **57** stores and manages the relay device ID of one relay device **30** finally selected by the final selecting unit **16***c* of the terminal **10** for every selection session ID in the session management DB **5005** (see FIG. **15**).

The quality deciding unit **58** decides the image quality of the image data to be relayed in the relay device **30** by retrieving the quality management DB **5007** (see FIG. **18**) by using the delay time as the retrieval key and extracting the corresponding image quality of the image data.

The storing/reading process unit **59** is implemented by a command from the CPU **201** illustrated in FIG. **6** and the HDD **205** illustrated in FIG. **6**. The storing/reading process unit **59** performs a process of storing various data in the storage unit **5000** and reading various data stored in the storage unit **5000**.

The delay time managing unit **60** is implemented by a command from the CPU **201** illustrated in FIG. **6**. The delay time managing unit **60** extracts the corresponding terminal ID by retrieving the terminal management DB **5003** (see FIG. **13**) by using the IP address of the destination terminal as the retrieval key. Further, the delay time managing unit **60** stores and manages the delay time represented by the delay information in a delay time field part in a record including the extracted terminal ID in the session management table of the session management DB **5005** (see FIG. **15**).

A Process or an Operation of the Embodiment

Next, a process method in the transmission system **1** according to the embodiment will be described with reference to FIGS. **19** to **26**. FIG. **19** is a sequence diagram illustrating a process of managing the state information representing the state of each relay device **30** transmitted from each relay device **30** to the management system **50**. FIG. **20** is a sequence diagram illustrating a process of a preparation step of starting a call between the plurality of terminals **10**. FIG. **21** is a sequence diagram illustrating a process of narrowing the relay device **30**. FIG. **22** is a flowchart illustrating a process of narrowing the relay device **30**. FIG. **23** is a diagram illustrating a point calculation state when performing a process of narrowing the relay device **30**. FIG. **24** is a sequence diagram illustrating a process of selecting the relay device **30** at the terminal **10**. FIG. **25** is a flowchart illustrating a process of selecting the relay device **30** at the terminal. FIG. **26** is a sequence diagram illustrating a process of transmitting and receiving image data and voice data between the terminals.

A process of managing the state information representing the state of each relay device **30** transmitted from each relay device **30** to the management system **50** will be first described with reference to FIG. **19**. First, in each relay device **30**, the state detecting unit **32** illustrated in FIG. **7** periodically detects the operation state of the relay device **30** that is its own device (step S**1**-**1** to step S**1**-**4**). In order for the management system **50** side to manage the operation of each relay device **30** in real time, the transceiving unit **31** of each relay device **30** periodically transmits each piece of state information to the management system **50** through the communication network **2** (step S**2**-**1** to step S**2**-**4**). Each piece of the state information includes the relay device ID of each relay device **30** and the operation state detected by the state detecting unit **32** of the relay device **30** related to each relay device ID. Further, in the present exemplary embodiment, described is the case in which the relay devices **30***a*, **30***b*, and **30***d* normally operate and are in the "on line" state, whereas the relay device **30***c* normally operates but is in the "off line" state because a failure occurs in the program for executing a relay operation of the relay device **30***c*.

Next, in the management system **50**, the transceiving unit **51** receives each piece of state information transmitted from each relay device **30**, and the storing/reading process unit **59** stores and manages the state information in the relay device management DB **5001** (see FIG. **11**) of the storage unit **5000** for every relay device ID (step S**3**-**1** to step S**3**-**4**). Thus, any one operation state of "on line," "off line," or "broken" is stored and managed in the relay device management table illustrated in FIG. **11** for every relay device ID. Further, at this time, the reception date and time in which the state information is received by the management system **50** is stored and managed for every relay device ID. Further, when the state information is not transmitted from the relay device **30**, the field part of the operation state and the field part of the reception date and time in each record of the relay device management table illustrated in FIG. **11** become empty or represent the operation state and the reception date and time that were received at the time of immediately previous reception.

Next, a transmission and reception process of each piece of management information at a preparation step before starting a call between the terminal **10***aa* and the terminal **10***db* will be described with reference to FIG. **20**. In FIG. **20**, a variety of management information is transmitted and received through the management information session sei illustrated in FIG. **2**.

First, when the user switches the power switch **109** illustrated in FIG. **5** to ON, the operation input receiving unit **12** illustrated in FIG. **7** receives power ON, and turns on the power (step S**21**). The login requesting unit **13** automatically transmits the login request information representing the login request to the management system **50** from the transceiving unit **11** through the communication network **2** upon reception of power ON (step S**22**). The login request information includes the terminal ID for identifying the terminal **10***aa* that is its own terminal as the request source and the password. The terminal ID and the password are data that is read from the storage unit **1000** by the storing/reading process unit **19** and transmitted to the transceiving unit **11**. When the login request information is transmitted to the management system **50** from the terminal **10***aa*, the management system **50** as the receiving side can recognize the IP address of the terminal **10***ab* as the transmitting side.

Next, the terminal authenticating unit **52** of the management system **50** retrieves the terminal authentication management DB **5002** (see FIG. **12**) of the storage unit **5000** using the terminal ID and the password included in the login request information received through the transceiving unit **51** as the retrieval key and determines whether or not the same terminal ID and password are managed in the terminal authentication management DB **5002** to perform terminal authentication (step S**23**). If the terminal authenticating unit **52** determines that the login request is transmitted from the terminal **10** having the authorized permissions since the same terminal ID and password are managed, the state managing unit **53** stores the terminal ID and the operation state of the terminal **10***aa*, the reception date and time in which the login request information is received, and the IP address of the terminal **10***aa* in the terminal management DB **5003** (see FIG. **13**) in association with each other (step S**24**). Thus, the terminal management table illustrated in FIG. **13** manages the operation state "on line," the reception date and time "2009.11.10. 13:40," and the IP address "1.2.1.3" of the terminal **10***aa* in association with the terminal ID "01aa."

The transceiving unit **51** of the management system **50** transmits authentication result information representing the authentication result obtained by the terminal authenticating unit **52** to the request source terminal (the terminal **10***aa*) that requested the login via the communication network **2** (step S**25**). In the present exemplary embodiment, the case in which the terminal authenticating unit **52** determines that the terminal has the authorized permissions will be continuously described below.

The terminal extracting unit **54** of the management system **50** retrieves the destination list management DB **5004** (see FIG. **14**) using the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) that requested the login as the retrieval key, and reads and extracts the terminal ID of the candidate of the destination terminal that can perform communications with the request source terminal (the terminal **10***aa*) (step S**26**). Here, the terminal IDs ("01ab," "01ba," and "01db") of the terminals (the terminals **10***ab*, **10***ba*, and **10***db*) corresponding to the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) are extracted.

Next, the terminal state acquiring unit **55** retrieves the terminal management DB **5003** (see FIG. **13**) by using the terminal IDs ("01ab," "01ba," and "01db") of the candidate of the destination terminal extracted by the terminal extracting unit **54** as the retrieval key and acquires the operation states of the terminals **10***ab*, **10***ba*, and **10***db* by reading the operation states ("off line," "on line," and "on line") of the terminal IDs extracted by the terminal extracting unit **54** (step S**27**).

Next, the transceiving unit **51** transmits the destination state information including the terminal IDs ("01ab," "01ba," and "01db") as the retrieval key used in step S**27** and the operation states ("off line," "on line," and "on line") of the destination terminals (the terminals **10***ab*, **10***ba*, and **10***db*) respectively corresponding thereto to the request source terminal (the terminal **10***aa*) via the communication network **2** (step S**28**). Thus, the request source terminal (the terminal **10***aa*) can recognize the present operation states ("off line," "on line," and "on line") of the terminals **10***ab*, **10***ba*, and **10***db* that are the candidates of the destination terminal that can communicate with the request source terminal (the terminal **10***aa*).

Further, the terminal extracting unit **54** of the management system **50** retrieves the destination list management DB **5004** (see FIG. **14**) by using the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) that requested the login as the retrieval key and extracts the terminal ID of another request source terminal that registered the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) as the candidate of the destination terminal (step S**29**). In the destination list management table illustrated in FIG. **14**, the extracted terminal IDs of another request source terminal are "01ab," "01ba," and "01db."

Next, the terminal state acquiring unit **55** of the management system **50** retrieves the terminal management DB **5003** (see FIG. **13**) by using the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) that requested the login as the retrieval key and acquires the operation state of the request source terminal (the terminal **10***aa*) that requested the login (step S**30**).

The transceiving unit **51** transmits the destination state information including the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) and the operation state "on line" acquired in step S**30** to the terminals "**10***ba*" and "**10***db*" whose operation states are set to "on line" in the terminal management DB **5003** (see FIG. **13**) among the terminals "**10***ab*," "**10***ba*," and "**10***db*" respectively corresponding to the terminal IDs "01ab," "01ba," and "01db" extracted in step S**29** (step S**31-1** and step S**31-2**). Further, when the transceiving unit **51** transmits the destination state information to the terminals **10***ba* and **10***db*, the IP address of the terminal managed in the terminal management table illustrated in FIG. **13** is referred based on the terminal IDs "01ba" and "01db." Thus, the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) that requested the login and the operation state "on line" can be transmitted to each of the destination terminals (the terminals **10***db* and **10***ba*) that can perform communications with the request source terminal (the terminal **10***aa*) that requested the login as the destination.

Meanwhile, even in another terminal **10**, if the user switches the power switch **109** illustrated in FIG. **6** to ON similar to step S**21**, the operation input receiving unit **12** illustrated in FIG. **7** receives power ON and performs a process similar to step S**22** to step S**31-1** and step S**31-2**, and thus a description thereof will not be repeated.

Subsequently, a process of narrowing the relay device **30** will be described with reference to FIG. **21**. In FIG. **21**, a variety of management information is transmitted and received through the management information session sei illustrated in FIG. **21**. Further, in the present exemplary embodiment, the request source terminal (the terminal **10***aa*) can communicate with at least one of the terminals **10***ba* and **10***db* whose operation states in the state information of the terminal received in step S**32** are "on line" among the terminals **10** as the destination candidate. Therefore, the case in

which the user of the request source terminal (the terminal **10***aa*) starts a call with the destination terminal (the terminal **10***db*) will be described below.

First, if the user presses the operation button **108** illustrated in FIG. **5** to select the terminal **10***db*, the operation input receiving unit **12** illustrated in FIG. **17** receives a request for starting a call with the destination terminal (the terminal **10***db*) (step S**41**). The transceiving unit **11** of the request source terminal (the terminal **10***aa*) transmits the start request information, which includes the terminal ID "01aa" of the terminal **10***aa* and the terminal ID "01db" of the destination terminal (the terminal **10***db*) and represents a request for starting a call, to the management system **50** (step S**42**). Thus, the transceiving unit **51** of the management system **50** receives the start request information and also can recognize the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*) that is the transmission source.

The state managing unit **53** changes the field parts of the operation states of the records respectively including the terminal ID "01aa" and the terminal ID "01db" in the terminal management table of the terminal management DB **5003** (see FIG. **13**) into "busy", based on the terminal ID "01aa" of the request source terminal (the terminal **10***aa*) and the terminal ID "01db" of the destination terminal (the terminal **10***db*) included in the start request information (step S**43**). In this state, the request source terminal (the terminal **10***aa*) and the destination terminal (the terminal **10***db*) do not start a call but are in the busy state. Thus, if another terminal **10** attempts to make a call with the request source terminal (the terminal **10***aa*) or the destination terminal (the terminal **10***db*), a notification sound or display representing the busy state is output.

Next, a process of executing a session for selecting the relay device **30** will be described. First, the selection session ID generating unit **56***a* illustrated in FIG. **9** generates the selection session ID used to execute the session for selecting the relay device **30** (step S**44**). The session managing unit **57** stores and manages the selection session "se1" generated in step S**44**, the terminal ID "01aa" of the request source terminal (the terminal **10***aa*), and the terminal ID "01db" of the destination terminal (the terminal **10***db*) in the session management DB **5005** (see FIG. **15**) of the storage unit **5000** in association with each other (step S**45**).

Next, the primary narrowing unit **56** of the management system **50** illustrated in FIG. **7** performs primary narrowing of the relay device **30** for relaying a call with the request source terminal (the terminal **10***aa*) and the destination terminal (the terminal **10***db*) based on the relay device management DB **5001**, the terminal management DB **5003**, and the priority management DB **5006** (step S**46**).

The process in step S**46** will be described in further detail with reference to FIGS. **9** and **22**. First, the terminal IP address extracting unit **56***b* illustrated in FIG. **9** retrieves the terminal management DB **5003** (see FIG. **13**) based on the terminal ID "01aa" of the request source terminal **10***aa* and the terminal ID "01db" of the destination terminal **10***db* included in the start communication information transmitted from the request source terminal (the terminal **10***aa*) and extracts the IP addresses "1.2.1.3" and "1.3.2.4" of the corresponding terminals **10***aa* and **10***db* (step S**46-1**).

Next, the primary selecting unit **56***c* selects the relay device IDs 111a, 111b, and 111d of the relay devices **30***a*, **30***b*, and **30***d* whose operation states are "on line" among the relay devices **30** managed in the relay device management DB **5001** (see FIG. **11**) (step S**46-2**). Further, the primary selecting unit **56***c* retrieves the relay device management DB **5001** (see FIG. **11**) based on the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*) and the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) extracted in step S**46-1** and investigates whether each dot address of the IP addresses "1.2.1.2," "1.2.2.2," and "1.3.2.2" of the relay devices **30***a*, **30***b*, and **30***d* selected in step S**46-2** is the same as or different from each dot address in the IP addresses "1.2.1.3" and "1.3.2.4" of the request source terminal (the terminal **10***aa*) and the destination terminal (the terminal **10***db*) (step S**46-3**).

Next, a priority deciding unit **57***c* decides the point of the address priority for each of the relay devices **30***a*, **30***b*, and **30***d* investigated in step S**46-3** with reference to the priority management DB **5006** (see FIG. **16**) (step S**46-4**). The result of the deciding process can be expressed as a table as illustrated in FIG. **23**. FIG. **23** is a view illustrating a point calculation state of the priority when performing the narrowing process of the relay device **30**. In FIG. **23**, the point of the address priority, the point of the transmission rate priority, and the integrated point are illustrated for every relay device ID. The point of the address priority includes the point of each relay device **30** on the request source terminal (the terminal **10***aa*) and the point on the destination terminal (the terminal **10***db*). The integrated point is a sum of a higher point of the two points of the address priority and the point of the transmission rate priority.

In the present exemplary embodiment, since the IP address "1.2.1.2" of the relay device **30***a* is "same.same.same.different" relative to the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*), the point of the address priority is "5" as illustrated in FIG. **23**. Further, since the IP address "1.2.1.2" of the relay device **30***a* is "same.different.different.different" relative to the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) as illustrated in FIG. **1**, the point of the address priority is "1" as illustrated in FIG. **23**. Further, since the IP address "1.2.2.2" of the relay device **30***b* is "same.same.different.different" relative to the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*), the point of the address priority is "3." Further, since the IP address "1.2.2.2" of the relay device **30***b* is "same.different.same.different" relative to the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*), the point of the address priority is "1." Further, since the IP address "1.3.2.2" of the relay device **30***d* is "same.different.different.different" relative to the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*), the point of the address priority is "1." Further, since the IP address "1.3.2.2" of the relay device **30***d* is "same.same.same.different" relative to the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*), the point of the address priority is "5."

Next, returning back to FIG. **22**, a priority deciding unit **57***d* retrieves the priority management DB **5006** (see FIG. **17**) based on the maximum transmission rate of each relay devices **30** managed in the relay device management DB **5001** (see FIG. **11**) and decides the point of the transmission rate priority of each of the relay devices **30***a*, **30***b*, and **30***d* narrowed by the primary narrowing process in step S**46-2** (step S**46-5**). In the present exemplary embodiment, since the maximum data transmission rate of the relay device **30***a* is 100 Mbps as illustrated in FIG. **11**, the point of the transmission rate priority is "3" by referring to the transmission rate priority illustrated in FIG. **17**. Similarly, since the maximum transmission rate of the relay device **30***b* is calculated as 1000 Mbps, the point of the transmission rate priority is "5." Further, similarly, since the maximum transmission rate of the relay device **30***d* is calculated as 10 Mbps, the point of the transmission rate priority is "1."

Next, the primary selecting unit **56***c* selects the two high-order relay devices **30** that are high in integrated point in

which the higher point of the terminals **10***aa* and **10***db* in the point of the address priority and the point of the transmission rate priority for each of the relay devices **30***a*, **30***b*, and **30***d* (step S**46-6**) are integrated. In the present exemplary embodiment, since the integrated points of the relay device IDs 111a, 111b, and 111d are "8," "8," and "6," respectively, as illustrated in FIG. **23**, the relay device **30***a* related to the relay device ID "111a" and the relay device **30***b* related to the relay device ID "111b" are selected.

When the narrowing process in step S**46** is completed, the transceiving unit **51** illustrated in FIG. **7** transmits the relay device narrowed-down information for transferring the number of the narrowed relay devices **30** to the destination terminal (the terminal **10***db*) via the communication terminal **2** (step S**47**). The relay device narrowed-down information includes "2" as the number of the relay devices **30** narrowed down in step S**46**, "01aa" as the terminal ID of the request source terminal (the terminal **10***aa*), and "se1" as the selection session ID. Thus, when executing the session in the selection session ID "se1," the terminal **10***db* can recognize the number of the relay devices **30** and whether or not there was a request of starting a call from a certain terminal **10** and also recognize the IP address "1.1.1.2" of the management system **50** that is the transmission source of the relay device narrowed-down information.

The terminal **10***db* transmits reception completion information representing that reception of the relay device narrowed-down information is completed to the management system **50** from the transceiving unit **11** via the communication network **2** (step S**48**). The reception completion information includes the session ID "se1." Thus, the management system **50** can recognize that transmission of the number of the relay devices being executed through the session ID "se1" is completed and the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) that is the transmission source.

Next, a process of selecting the relay device **30** through the destination terminal (the terminal **10***db*) will be described with reference to FIGS. **24** and **25**. In FIG. **24**, a variety of management information is transmitted and received through the management information session sei illustrated in FIG. **2**.

First, before starting a video conference call, the management system **50** transmits prior relay request information for requesting a relay in advance to each of the relay devices **30***a* and **30***b* narrowed down in step S**46** (step S**61-1** and step S**61-2**). The prior relay request information includes the session ID "se1," the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*), and the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*). Thus, each of the relay devices **30***a* and **30***b* can recognize the selection session, the request source terminal, and the destination terminal and also recognize the IP address "1.1.1.2" of the management system **50** that is the transmission source of the prior relay request information.

Next, each of the relay devices **30***a* and **30***b* transmits prior transmission request information, which represents that prior transmission information including a packet Internet groper (ping) which will be described later should be transmitted to each of the relay devices **30***a* and **30***b* as its own device before the call start, from the transceiving unit **31** to the request source terminal (the terminal **10***aa*) recognized in steps S**61-1** and S**61-2** via the communication network **2** (steps S**62-1** and S**62-2**). The prior transmission information includes the session ID "se1." Thus, the request source terminal (the terminal **10***aa*) can recognize that the prior transmission information is transmitted to each of the relay devices **30***a* and **30***b* in the process of selecting the relay device **30** being executed through the session ID "se1" and the IP addresses "1.2.1.2" and "1.2.2.2" of the relay devices that are the transmission sources of the prior transmission request information.

The reason why the IP address of the destination terminal is not notified from the management system **50** directly to the request source terminal, the IP address of the destination terminal is notified to the relay device **30***a* as in step S**61-1**, and the relay device **30***a* requests the request source terminal to transmit the prior transmission request information to its own device (the relay device **30***a*) as in step S**61-2** is to secure security by not informing each terminal **10** of the IP address of another terminal **10**.

Next, the request source terminal (the terminal **10***aa*) transmits the prior transmission information to each of the relay devices **30***a* and **30***b* from the transceiving unit **11** via the communication network **2** (steps S**63-1** and S**63-2**). The prior transmission information is information that is transmitted to the destination terminal (the terminal **10***db*) through each of the relay devices **30***a* and **30***b* prior to the image data and the voice data instead of the image data and the voice data and used for measuring a required time between transmission of the request source terminal (the terminal **10***aa*) and reception of the destination terminal (the terminal **10***db*). The prior transmission information includes a ping for checking whether or not the request source terminal (the terminal **10***aa*), the relay devices **30***a* and **30***b*, and the destination terminal (the terminal **10***db*) are connected to be capable of performing communications, the transmission date and time in which the prior transmission information is transmitted from the request source terminal (the terminal **10***aa*), and the session ID "se1." Thus, when executing the session through the selection session ID "se1," each of the relay devices **30***a* and **30***b* can recognize that the prior transmission information is received, and at the same time, recognize the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*) that is the transmission source of the prior transmission information.

Next, each of the relay devices **30***a* and **30***b* relays the prior transmission information to the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) included in the prior relay request information received in step S**61-1** and step S**61-2** (step S**64-1** and step S**64-2**). Thus, when executing the session in the session ID "se1," the destination terminal (the terminal **10***db*) can recognize that the prior transmission information is received, and at the same time, recognize the IP addresses "1.2.1.2" and "1.2.2.2" of the relay devices **30***a* and **30***b* that are the transmission sources (the relay sources) of the prior transmission information.

Next, the final narrowing unit **16** of the destination terminal (the terminal **10***db*) narrows down one relay device **30** that finally relays the image data and the voice data in the video conference call based on the prior transmission information (step S**65**).

The process in step S**65** will be described in further detail with reference to FIGS. **8** and **25**. First, the measuring unit **16***a* of the final narrowing unit **16** illustrated in FIG. **8** measures the reception date and time in which each piece of the prior transmission information relayed by each of the relay devices **30***a* and **30***b* is received by the transceiving unit **11** of the terminal **10***db* (step S**65-1**). Next, the calculating unit **16***b* calculates the required time between transmission and reception of each piece of the prior transmission information based on the difference between the reception date and time of each piece of the prior transmission information in which the reception time is measured and the transmission date and time included in the prior transmission information (step S**65-2**). Next, when executing the session in the session ID "se1," the final selecting unit **16***c* determines whether or not all of as

many prior transmission information as the number "2" of the relay devices **30** that are scheduled to relay is received (step **S65-3**). If all of the prior transmission information is not received yet (NO), the final selecting unit **16***c* determines whether or not a predetermined time (herein, one minute) elapses after the terminal **10***db* receives the prior transmission information (step **S65-4**). If the predetermined time did not elapse (NO), the process returns to step **S65-1**. However, if it is determined in step **S65-3** that all of the prior transmission information is received (YES) or if it is determined in step **S65-4** that the predetermined time elapsed (YES), the final selecting unit **16***c* selects one relay device **30** that relayed the prior transmission information in which the shortest required time is taken among the required times calculated by the calculating unit **16***b* so far (step **S65-5**). In the present exemplary embodiment, described is an example in which the prior transmission information relayed by the relay device **30***a* is shorter in required time than the prior transmission information relayed by the relay device **30***b*, and thus the relay device **30***a* is selected.

Next, the destination terminal (the terminal **10***db*) transmits selection information representing selection of the relay device **30***a* from the transceiving unit **11** via the communication network **2** (step **S66**). The selection information includes the session ID "se1" and the relay device ID "111a" of the selected relay device **30***a*. Thus, the management system **50** can recognize that the relay device **30***a* is selected, and at the same time, recognize the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) that is the transmission source of the selection information.

Next, the session managing unit **57** of the management system **50** stores and manages the relay device ID "111a" of the finally selected one relay device **30***a* in the field part of the relay device ID of the record including the session ID "se1" in the session management table of the session management DB **5005** (see FIG. **15**) (step **S67**). The transceiving unit **51** of the management system **50** transmits relay start request information representing the start of the relay to the relay device **30***a* via the communication network **2** (step **S68**). The relay start request information includes the IP addresses "1.2.1.3" and "1.3.2.4" of the request source terminal (the terminal **10***aa*) to be relayed and the destination terminal (the terminal **10***db*). Thus, since it is possible to recognize that the relay device **30***a* that is its own device is selected, the relay device **30***a* establishes a session for transmitting and receiving the three items of image data including the low resolution, the intermediate resolution, and the high resolution and the voice data between the terminals **10***aa* and **10***db* (step **S69**). Thus, the terminals **10***aa* and **10***db* can start the video conference call.

As the management system **50** transmits the relay device narrowed-down information to the destination terminal (the terminal **10***db*) in step **S47**, the destination terminal (the terminal **10***db*) side performs the process (step **S65**) of selecting the relay device through step **S48** to step **S64-1** and step **S64-2**. However, the present invention is not limited thereto, and as the management system **50** transmits the relay device narrowed-down information to the request source terminal (the terminal **10***aa*) in step **S47**, the transmission source and the reception source of each information may be replaced with the request source terminal (the terminal **10***aa*) and the destination terminal (the terminal **10***db*) until step **S64-1** and step **S64-2**. Thus, the request source terminal (the terminal **10***aa*) may perform the process of selecting the relay device instead of step **S65** and perform transmission of the selection information instead of step **S66**.

Subsequently, a process of transmitting and receiving the image data and the voice data to perform the video conference call between the request source terminal and the destination terminal will be described with reference to FIGS. **7** and **26**. In one direction process in which the image data and the voice data are transmitted from the terminal **10***aa* to the terminal **10***db* and in a reverse direction process in which the image data and the voice data are transmitted from the terminal **10***db* to the terminal **10***aa*, transmission and reception of the image data and the voice data or detection of the delay time which will be described later are the same process. Thus, one direction communication will be described, and a description of the reverse direction communication will be omitted.

First, the request source terminal (the terminal **10***aa*) transmits image data of a subject whose image is captured by an image capturing unit **14***a* and voice data of a voice input by the voice input unit **15***a* from the transceiving unit **11** to the relay device **30***a* via the communication network **2** through an image/voice data session sed illustrated in FIG. **2** (step **S81**). In the present exemplary embodiment, the high quality image data including the low resolution, the intermediate resolution, and the high resolution and the voice data illustrated in FIGS. **3**A to **3**C are transmitted. Thus, the relay device **30***a* receives the image data of the three resolutions and the voice data through the transceiving unit **31**. The data quality confirming unit **33** confirms the image quality of the image data to be relayed by retrieving the quality change management DB **3001** (see FIG. **10**) by using the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) as the retrieval key and extracting the corresponding image quality of the image data to be relayed (step **S82**). In the present exemplary embodiment, since the confirmed image quality of the image data is the "high image quality" and is the same as the image quality of the image data received by the transceiving unit **31**, the relay device **30***a* transmits the image data having the same image quality and the voice data having the same sound quality to the destination terminal (the terminal **10***db*) "as is" through the image/voice data session sed (step **S83**). Thus, the destination terminal (the terminal **10***db*) receives the high quality image data including the low resolution, the intermediate resolution, and the high resolution and the voice data through the transceiving unit **11**. The display control unit **17** combines the image data of the three image qualities and displays the image on the display **120**, and the voice output unit **15***b* outputs a voice based on the voice data.

Next, the delay detecting unit **18** of the terminal **10***db* detects the reception delay time of the image data received by the transceiving unit **11** at a predetermined time interval (for example, at an interval of one second) (step **S84**). In the present exemplary embodiment, a description will be made in connection with a case in which the delay time is 200 ms.

The transceiving unit **11** of the destination terminal (the terminal **10***db*) transmits the delay information representing the delay time "200 ms" to the management system **50** through the management information session sei via the communication network **2** (step **S85**). Thus, the management system **50** can recognize the delay time and the IP address "1.3.2.4" of the terminal **10***db* that is the transmission source of the delay information.

Next, the delay time managing unit **60** of the management system **50** retrieves the terminal management DB **5003** (see FIG. **13**) by using the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) as the retrieval key and extracts the corresponding terminal ID "01db." The delay time managing unit **60** stores and manages the delay time "200 ms" represented by the delay information in the delay time field part in the record of the terminal ID "01db" in the session management table of the session management DB **5005** (see FIG. **15**) (step **S86**).

Next, the quality deciding unit **58** decides the "intermediate image quality" as the image quality by retrieving the quality management DB **5007** (see FIG. **18**) by using the delay time "200 ms" as the retrieval key and extracting the "intermediate image quality" as the image quality of the corresponding image data (step S**87**).

Next, the transceiving unit **51** retrieves the relay device management DB **5001** (see FIG. **11**) by using the relay device ID "111a" related to the terminal ID "01db" in the session management table of the session management DB (see FIG. **15**) as the retrieval key and extracts the IP address "1.2.1.2" of the corresponding relay device **30***a* (step S**88**). The transceiving unit **51** transmits the quality information representing the "intermediate image quality" as the image quality decided in step S**87** to the relay device **30***a* through the management information session sei illustrated in FIG. **2** via the communication network **2** (step S**89**). The quality information includes the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) used as the retrieval key in step S**86**. Thus, the quality change managing unit **34** in the relay device **30***a* stores and manages the IP address "1.3.2.4" of the terminal **10** (here, the terminal **10***db*) of the transmission destination and the "intermediate image quality" as the image quality of the image data to be relayed in the quality change management DB **3001** (see FIG. **10**) (step S**90**) in association with each other.

Subsequently, the terminal **10***aa* transmits the high quality image data including the low resolution, the intermediate resolution, and the high resolution and the voice data to the relay device **30** through the voice/image data session sed similarly to step S**81** (step S**91**). Similarly to step S**82**, in the relay device **30***a*, the data quality confirming unit **33** confirms the image quality of the image data to be relayed by retrieving the quality change management DB **3001** (see FIG. **10**) by using the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) as the retrieval key and extracting the "intermediate image quality" as the corresponding image quality of the image data to be relayed (step S**92**). In the present exemplary embodiment, since the confirmed image quality of the image data is the "intermediate image quality" and is lower than the image quality of the image data received by the transceiving unit **31**, the data quality changing unit **35** changes the image quality of the image data by reducing the image quality of the image data from the "high image quality" to the "intermediate image quality" (step S**93**).

The transceiving unit **31** transmits the image data in which the image quality of the image data was changed to the "intermediate image quality" and the voice data whose sound quality did not change to the terminal **10***db* through the image/voice data session sed via the communication network **2** (step S**94**). Thus, the destination terminal (the terminal **10***db*) receives the high quality image data including the low resolution and the intermediate resolution and the voice data through the transceiving unit **11**. The display control unit **17** combines the image data of the two image resolutions and displays the image on the display **120**, and the voice output unit **15***b* outputs a voice based on the voice data.

If the reception delay occurs in the destination terminal (the terminal **10***db*) that receives the image data as described above, the relay device **30***a* changes the image quality without giving an uncomfortable feeling to a person who participates in the video conference.

Main Effects of the Present Exemplary Embodiment

As described above, according to the present exemplary embodiment, since it is difficult to grasp the whole environment of the Internet **2***i* even though it is possible to grasp the LAN environment such as the IP address of the relay device **30** in the communication network **2**, the plurality of relay devices **30** that relay the image data and the voice data are narrowed down to two relay devices based on the environment information that can be grasped. Next, by transmitting and receiving the prior transmission information instead of the image data and the voice data before actually transmitting and receiving the image data and the voice data between the plurality of terminals **10**, there is an effect of being capable of narrowing the replay devices **30** down to one replay device which can actually relay the prior transmission information most rapidly.

That is, by selecting the relay devices **30** that are respectively allocated two high-order addresses closes to any one of the IP addresses of the terminals **10**, the two relay devices **30** remain as candidates to be finally used. Thereafter, by actually transmitting the prior transmission information between the request source terminal and the destination terminal through each of the candidate relay devices **30**, the two candidate relay devices **30** can be narrowed down to the relay device **30** that relayed the prior transmission information with the shortest required time taken in transmission and reception. Thus, there is an effect of being capable of realizing transmission and reception of the image data or the voice data with as high quality as possible in the environment of the present communication network **2**.

Further, in the present exemplary embodiment, when narrowing down the relay devices **30**, the relay device **30** having the IP address close to the IP address of the terminal **10** that performs the video conference is first selected, and the two or more relay devices **30** are selected in view of the maximum data transmission rate in each of the relay devices **30**. Thus, there is an effect of being capable of narrowing the candidates of the relay devices according to the environment of the present communication network **2**.

Further, in the present exemplary embodiment, when narrowing down the relay devices **30**, the relay device **30** whose operation state is "on line" is selected. Thus, the candidate of the relay device **30** more suitable for the environment of the present communication network **2** can be selected.

Second Embodiment

Hereinafter, a second exemplary embodiment of the present invention will be described with reference to FIG. **27**. FIG. **27** is a sequence diagram illustrating a process of selecting the relay device at the terminal according to the second exemplary embodiment of the present invention. The present exemplary embodiment is different from the first exemplary embodiment in a process or operation in FIGS. **27** and **24**, and thus a description will be made below in connection with the differences in a process or operation.

A Process or Operation of the Exemplary Embodiment

In step S**61-1**, step S**62-1**, step S**61-2**, and step S**62-2** in FIG. **24** of the first exemplary embodiment, it is required that the management system **50** transmits the prior request information to the request source terminal (the terminal **10***aa*) through each of the relay devices **30***a* and **30***b*, whereas in the present exemplary embodiment, the management system **50** transmits the prior request information directly to the request source terminal (the terminal **10***aa*).

That is, in the present exemplary embodiment, as illustrated in FIG. **27**, the management system **50** first transmits the prior transmission request information to the request source terminal (the terminal **10***aa*) (step S**161**). In this case, the prior transmission request information includes the session ID "se1," the IP addresses "1.2.1.2" and "1.2.2.2" of the primary-narrowed relay devices **30***a* and **30***b* and the IP

address "1.3.2.4" of the destination terminal (the terminal **10***db*). Thus, the request source terminal (the terminal **10***aa*) can recognize the selection session, the relay device **30** as the candidate finally narrowed by primary narrowing, and the IP address of the destination terminal (the terminal **10***db*). Further, the request source terminal (the terminal **10***aa*) can recognize the IP address "1.1.1.2" of the management system **50** that is the transmission source of the prior transmission request information.

Next, the request source terminal (the terminal **10***aa*) transmits the prior transmission information to the relay devices **30***a* and **30***b* (step S**162-1** and step S**162-2**). Similarly to step S**63-1** and step S**63-2** in the first exemplary embodiment, the prior transmission information includes not only the ping, the transmission date and time in which the prior transmission information is transmitted from the request source terminal (the terminal **10***aa*), and the session ID "se1" but also the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*). Thus, each of the relay devices **30***a* and **30***b* can recognize that the prior transmission information is received in execution of the session in the selection session ID "se1," and at the same time, recognize the IP address "1.2.1.3" of the request source terminal (the terminal **10***aa*) that is the transmission source of the prior transmission information. Further, the IP address "1.3.2.4" of the destination terminal (the terminal **10***db*) that is the transmission destination of the prior transmission information can be recognized. Thus, each of the relay devices **30***a* and **30***b* can transmit (or transfer) the prior transmission information to the acquired IP address of the destination terminal (the terminal **10***db*).

Further, step S**163-1**, step S**163-2** to step S**168** in FIG. **27** are the same processes as in step S**64-1** and step S**64-2** to step S**69** of FIG. **24** in the first exemplary embodiment, and thus a description thereof will not be repeated.

Main Effects of the Present Exemplary Embodiment

As described above, according to the present exemplary embodiment, the same effects as the main effects in the first exemplary embodiment are obtained.

However, since the request source terminal is informed of the IP address of the destination terminal, the present exemplary embodiment is inferior in security aspect to the first exemplary embodiment. For example, however, in the first exemplary embodiment, when a firewall is installed to secure confidentiality of the LAN **2***a* illustrated in FIG. **1**, there is a case in which the prior transmission request information in step S**62-2** cannot be transmitted from the relay device **30***b* to the request source terminal (the terminal **10***aa*). On the other hand, in the present exemplary embodiment, since one which transmits the prior transmission request information to the request source terminal is not the relay device **30** side, there does not occur a problem in that the prior transmission request information cannot be transmitted. Further, in this case, the management system **50** is on the communication network outside the firewall, but a connection between the terminal **10***aa* and the management system **50** is already established, as illustrated in FIG. **20**, so that the management system **50** can transmit the prior transmission request information to the terminal **10***aa* through the firewall.

Supplemental Embodiment

The relay device **30**, the management system **50**, the program providing system **90**, and the maintenance system **100** of the exemplary embodiments may be constructed by a single computer or each unit (function or means) thereof may be divided and constructed by a plurality of arbitrarily allocated computers. If the program providing system **90** is constructed by a single computer, a program to be transmitted by the program providing system may be divided into a plurality of modules and then transmitted or may be transmitted without being divided. If the program providing system **90** is constructed by a plurality of computers, transmission from each of the computers may be performed in a state in which a plurality of modules is divided.

All of the recording medium such as a CD-ROM storing the terminal program, the relay device program, or the transmission management program of the exemplary embodiments, the HD **204** storing the programs, and the program providing system **90** having the HD **204** are program products and are used in the case in which the terminal program, the relay device program, and the transmission management program are provided to the users within the country and abroad.

Further, in the exemplary embodiments, management is performed focusing on the resolution of the image of the image data as an example of the image quality of the image data to be relayed by the relay device **30** according to the quality change management table illustrated in FIG. **10** and the quality management table illustrated in FIG. **18**. However, the present invention is not limited thereto, and management may be performed focusing on the depth of the image quality of the image data, the sampling frequency in a voice of the voice data, or the bit length in a voice of the voice data as another example. Further, the voice data may be divided into data of three kinds of resolutions (high resolution, intermediate resolution, and low resolution) and then transmitted.

Further, in FIGS. **11**, **13**, and **15**, the reception date and time is managed. However, the present invention is not limited thereto, and at least the reception time of the reception date and time is preferably managed.

Further, in the exemplary embodiment, the IP address of the relay device and the IP address of the terminal are managed in FIGS. **11** and **13**, respectively. However, the present invention is not limited thereto, and in the case of relay device-specifying information for specifying the relay device **30** in the communication network **2** or terminal-specifying information for specifying the terminal **10** in the communication network **2**, a fully qualified domain name (FQDN) may be managed. In this case, an IP address corresponding to the FQDN is acquired by a well known domain name system (DNS) server. Further, "relay device connection destination information representing a connection destination to the relay device **30** in the communication network **3**" or "relay device destination information representing a destination to the relay device **30** in the communication network **2**" as well as "relay device-specifying information for specifying the relay device **30** in the communication network **2**" may be expressed. Similarly, "terminal connection destination information representing a connection destination to the terminal **10** in the communication network **3**" or "terminal destination information representing a destination to the terminal **10** in the communication network **2**" as well as "terminal-specifying information for specifying the terminal **10** in the communication network **2**" may be expressed.

Further, in the exemplary embodiment, the video conference system is described as an example of the transmission system **1**. However, the present invention is not limited thereto, and a telephone system such as an IP telephone or an Internet telephone may be used. Further, as the transmission system **1**, a car navigation system may be used. In this case, for example, one of the terminals **10** corresponds to a car navigation device mounted in an automobile, and the other of the terminals **10** corresponds to a management terminal or a management server of a management center that manages car navigation or a car navigation device mounted in another

automobile. Further, the transmission system **1** may be a cellular phone communication system. In this case, for example, the terminal **10** corresponds to a cellular phone.

Further, in the exemplary embodiment, the image data and the voice data are described as an example of contents data. However, the present invention is not limited thereto, and touch data may be used. In this case, a sense of touch caused by the user in one terminal is transmitted to the other terminal. Further, as the contents data, smell data may be used. In this case, smell of one terminal is transmitted to the other terminal. Further, as the contents data, at least one of the image data, the voice data, the touch data, and the smell data is preferably used.

Further, in the exemplary embodiment, the case in which the video conference is held by the transmission system **1** is described. However, the present invention is not limited thereto and may be used in a meeting, a general conversation with families or friends, or giving information in one direction.

The invention claimed is:

1. A transmission terminal that transmits and receives content data to and from another transmission terminal through a predetermined relay device that relays the content data, the transmission terminal comprising:

a receiver to receive a plurality of pieces of prior transmission information that are transmitted from the another transmission terminal before the content data is transmitted, and are respectively relayed through a plurality of relay devices, each piece of prior transmission information including a transmission time when transmitted from the another transmission terminal and including relay device identification information indicating a relay device that has relayed the prior transmission information among the plurality of relay devices;

a processing circuit to

measure a reception time of each piece of prior transmission information,

calculate, for each piece of prior transmission information whose reception time has been measured, a time between transmission and reception of the prior transmission information based on a difference between the measured reception time and the transmission time included in the prior transmission information, and

select a relay device that is represented by the relay device identification information included in the prior transmission information corresponding to the shortest time among the calculated times, and

a transmitter to transmit the content data to the another transmission terminal through the selected relay device.

2. The transmission terminal according to claim **1**, wherein

the receiver receives relay device number information that is transmitted from the another transmission terminal and represents the number of relay devices that are scheduled to relay the pieces of prior transmission information, and

the processing circuit calculates a required time between transmission and reception of each piece of the prior transmission information, the number of which corresponds to the number of the relay devices represented by the received relay device number information.

3. The transmission terminal according to claim **1**, wherein

the receiver receives relay device number information that is transmitted from the another transmission terminal and includes the number of relay devices that are scheduled to relay the pieces of prior transmission information, and

the processing circuit calculates a required time between transmission and reception of only the prior transmission information received within a predetermined time after the receiver receives the relay device number information.

4. The transmission terminal according to claim **1**, wherein the relay device identification information is address information of the relay device.

5. The transmission terminal according to claim **1**, wherein the transmission terminal notifies a management system, which manages the transmission terminal and the another transmission terminal, of information of the selected relay device, so as to establish a session for transmitting and receiving the content data with the selected relay device.

6. A transmission method for transmitting and receiving content data to and from another transmission terminal through a predetermined relay device that relays the content data, the method comprising:

receiving a plurality of pieces of prior transmission information that are transmitted from the another transmission terminal before the content data is transmitted, and are respectively relayed through a plurality of relay devices, each piece of prior transmission information including a transmission time when transmitted from the another transmission terminal and including relay device identification information indicating a relay device that has relayed the prior transmission information among the plurality of relay devices;

measuring a reception time of each piece of prior transmission information;

calculating, for each piece of prior transmission information whose reception time has been measured, a time between transmission and reception of the prior transmission information based on a difference between the measured reception time and the transmission time included in the prior transmission information;

selecting a relay device that is represented by the relay device identification information included in the prior transmission information corresponding to the shortest time among the calculated times; and

transmitting the content data to the another transmission terminal through the selected relay device.

7. A non-transitory computer readable medium storing a program that, when executed by a processor, causes the processor to execute a transmission method for transmitting and receiving content data to and from another transmission terminal through a predetermined relay device that relays the content data, the method comprising:

receiving a plurality of pieces of prior transmission information that are transmitted from the another transmission terminal before the content data is transmitted, and are respectively relayed through a plurality of relay devices, each piece of prior transmission information including a transmission time when transmitted from the another transmission terminal and including relay device identification information indicating a relay device that has relayed the prior transmission information among the plurality of relay devices;

measuring a reception time of each piece of prior transmission information;

calculating, for each piece of prior transmission information whose reception time has been measured, a time between transmission and reception of the prior transmission information based on a difference between the measured reception time and the transmission time included in the prior transmission information;

selecting a relay device that is represented by the relay device identification information included in the prior transmission information corresponding to the shortest time among the calculated times; and

transmitting the content data to the another transmission terminal through the selected relay device.

8. A transmission system, comprising:

a transmission terminal;

another transmission terminal; and

a plurality of relay devices, wherein the transmission terminal transmits and receives content data to and from the another transmission terminal through a predetermined relay device that relays the content data, the transmission terminal including

a receiver to receive a plurality of pieces of prior transmission information that are transmitted from the another transmission terminal before the content data is transmitted, and are respectively relayed through the plurality of relay devices, each piece of prior transmission information including a transmission time when transmitted from the another transmission terminal and including relay device identification information indicating a relay device that has relayed the prior transmission information among the plurality of relay devices;

a processing circuit to

measure a reception time of each piece of prior transmission information,

calculate, for each piece of prior transmission information whose reception time has been measured, a time between transmission and reception of the prior transmission information based on a difference between the measured reception time and the transmission time included in the prior transmission information, and

select a relay device that is represented by the relay device identification information included in the prior transmission information corresponding to the shortest time among the calculated times, and

a transmitter to transmit the content data to the another transmission terminal through the selected relay device.

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